

# East Traffic Circle Landfill Closure Report

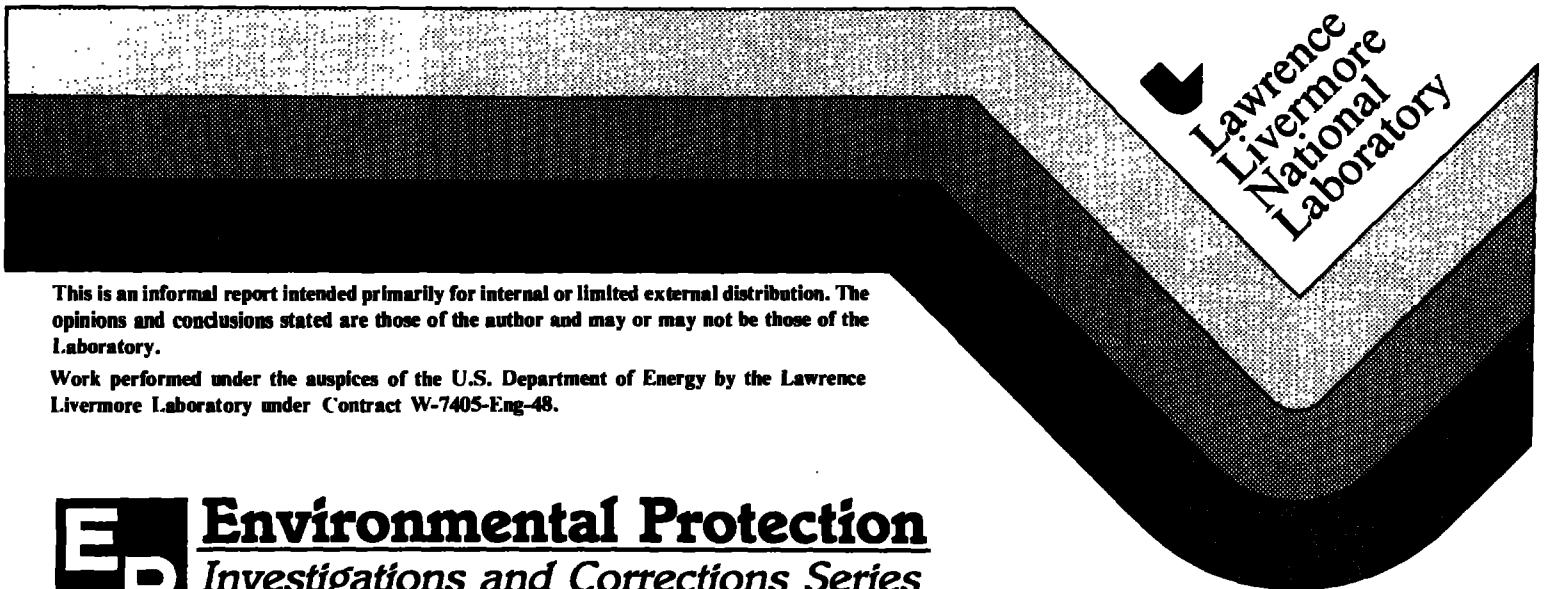
William A. McConachie

Joseph P. Como

David W. Carpenter

Richard C. Ragaini

January 31, 1986



This is an informal report intended primarily for internal or limited external distribution. The opinions and conclusions stated are those of the author and may or may not be those of the Laboratory.

Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore Laboratory under Contract W-7405-Eng-48.



**Environmental Protection**  
*Investigations and Corrections Series*

# **DISCLAIMER**

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

Printed in the United States of America  
Available from  
National Technical Information Service  
U.S. Department of Commerce  
5285 Port Royal Road  
Springfield, VA 22161

<u>Price Code</u>	<u>Page Range</u>
A01	Microfiche
<u>Papercopy Prices</u>	
A02	001-050
A03	051-100
A04	101-200
A05	201-300
A06	301-400
A07	401-500
A08	501-600
A09	601

## **Preface**

**The Environmental Protection Program produces the following document series:**

**Guidance and Support Series  
Verification Monitoring Series  
Investigations and Corrections Series  
Hazardous Waste Management Series**

**This is the second report of the Investigations and Corrections Series. The first report in this series is:**

**Investigation of Tritium in Groundwater at Site 300, UCID-20600,  
Robert W. Buddemeier, December 30, 1985**



# **EAST TRAFFIC CIRCLE LANDFILL CLOSURE REPORT**

## **Table of Contents**

<b>Table of Contents</b>	<b>iii</b>
<b>List of Figures</b>	<b>v</b>
<b>List of Tables</b>	<b>vi</b>
<b>Executive Summary</b>	<b>vii</b>
<b>1. Introduction</b>	<b>1</b>
1.1 General Site History and Characteristics	1
1.2 Nature and Extent of Problem	2
1.3 Investigation Chronology	5
<b>2. Site Features</b>	<b>7</b>
2.1 Climatology	7
2.2 Geology	7
2.3 Hydrogeology	12
<b>3. Methods</b>	<b>15</b>
3.1 Backhoe Investigations	15
3.2 Soil Borings	15
3.3 Sample Collection, Handling, and Preservation	15
3.4 Analytical Procedures	16
3.4.1 Radioactivity	16
3.4.2 Metals	16
3.4.3 Asbestos and Fluorides	16
3.4.4 PCBs	16
3.4.5 Mobility of Metals - Soil pH and Cation Exchange Capacity (CEC) Analyses	17
3.4.6 Soil Sieve and Proctor Density Analyses	17
3.5 Geophysical Investigations	17
3.5.1 Magnetometer Surveys	17
3.5.2 Electromagnetic or Conductivity Survey	18
3.5.3 Resolution of Geophysical Anomalies	18
3.6 Excavation, Storage, and Disposal of Wastes and Contaminated Soil	18
3.7 Health, Environmental, and Safety Procedures	19
3.8 Decontamination of Equipment	19

**Table of Contents (continued)**

<b>4. Results and Discussion</b>	<b>21</b>
4.1 Backhoe Investigations	21
4.2 Descriptions and Locations of Waste Types	28
4.3 Soil Borings	36
4.4 Post Cleanup Samplings	42
4.4.1 Landfill Area	42
4.4.2 Waste Piles	43
4.4.3 Waste Storage Area After Removal of Piles	44
4.5 Chronology of Sampling Events	44
4.6 Mobility of Metals - pH, Cation Exchange Capacity, and PCBs	49
4.7 Soil Sieve and Proctor Density Analysis and Backfilling	50
4.8 Geophysical Investigations	51
4.9 Waste Storage and Disposal	54
4.9.1 Quantity Stored and Location	54
4.9.2 Storage Procedures	54
4.9.3 Disposal Procedures	54
<b>5. Closure of the East Traffic Circle Landfill</b>	<b>55</b>
5.1 Condition of Landfill	55
5.2 Mitigation Measures	55
<b>6. Continuing Investigations</b>	<b>57</b>
<b>Acknowledgments</b>	<b>57</b>
<b>References</b>	<b>57</b>
<b>Appendices:</b>	
Appendix A	A-1
Appendix B	B-1
Appendix C	C-1
Appendix D	D-1
Appendix E	E-1
Appendix F	F-1

## List of Figures

Fig. 1. Location of the East Traffic Circle on the LLNL site (circa 1960).	1
Fig. 2. Utility lines passing through the landfill area.	3
Fig. 3. Locations of soil sampling holes.	8
Fig. 4. Geologic cross section. This represents geologic survey trench A - A' as indicated in Fig. 3.	9
Fig. 5. Geologic cross section. This represents geologic survey trench B - B' as indicated in Fig. 3.	11
Fig. 6. Elevated contours on potentiometric surface, winter 1983-4 LLNL and adjacent area.	12
Fig. 7. Hydrograph of monitoring well MW10A bailed dry on November 26, 1980.	13
Fig. 8. Soil tritium profile at monitoring well MW16. Water table estimated at 24 to 30 m (80 to 100 feet).	14
Fig. 9. Excavated soil placed on 30-mil synthetic base.	19
Fig. 10. Capacitors removed during backhoe investigations. Capacitors were placed on 30-mil poly-vinyl sheeting and tested for PCBs.	22
Fig. 11. Locations of short trenches and test holes.	23
Fig. 12. Soil bore sampling locations.	25
Fig. 13. Location of samples analyzed by x-ray fluorescence (Appendix A).	27
Fig. 14. Layer of waste fragments within five feet of the ground surface.	28
Fig. 15. Locations of waste areas.	29
Fig. 16. Two sizes of PCB capacitors uncovered during the excavation.	30
Fig. 17. Example of empty drums found during the excavation.	31
Fig. 18. Drum containing epoxy resin DER332 uncovered during excavation.	32
Fig. 19. Drum discovery sites and old waste pit with chemical analyses	33
Fig. 20. Chemical analysis of drum containing DER332 (from Fig. 18).	34
Fig. 21. Excavated area in the East Traffic Circle Landfill.	35
Fig. 22. Relationship of total concentration to soluble concentration for nickel.	37
Fig. 23. Relationship of total concentration to soluble concentration for barium.	37
Fig. 24. Relationship of total concentration to soluble concentration for copper.	38
Fig. 25. Relationship of total concentration to soluble concentration for lead.	38
Fig. 26. Locations of PCB-capacitors and soil analyses.	39
Fig. 27. PCB sample locations and analyses.	41
Fig. 28. After confirmation of the sampling analysis, the area was backfilled and returned to grade.	42
Fig. 29. Location of contaminated soil piles, October 1984.	43
Fig. 30. Locations of samples collected from the waste-pile storage area after the removal of the piles.	47
Fig. 31. Contaminated dirt piles - 6/26/85.	48
Fig. 32. Sensitivity of predicted total soluble metals as pH varies.	49
Fig. 33. Corrugated drain pipe that caused a magnetometer anomaly.	52
Fig. 34. Corrugated drain pipe that caused a magnetometer anomaly.	52
Fig. 35. Unused electrical conduit that caused a magnetometer anomaly.	52
Fig. 36. Contour map of magnetometer survey area.	53
Figs. F-1 through F-7.	F-6

## **List of Tables**

### **Appendix A:**

Table 1	Results from Core Sample Taken Below Hole A-3 . . . . .	A-1
Table 2	Metals Analysis by X-ray Fluorescence . . . . .	A-2
Table 3	Results of PHA Radioactivity Analyses . . . . .	A-3
Table 4	Results of Chromatography/Mass Spectrometry - EPA Method 624 .	A-4
Table 5	Results of Chromatography/Mass Spectrometry - EPA Method 625 .	A-5
Table 6	Results of Chromatography/Mass Spectrometry - EPA Method 8240 .	A-6

### **Appendix B:**

Table 1	Soil Cores - East Traffic Circle Landfill . . . . .	B-1
Table 2	Total Concentrations . . . . .	B-11
Table 3	Total PCBs . . . . .	B-40
Table 4	Total PCBs . . . . .	B-41
Table 5	California Waste Extraction Test . . . . .	B-43

### **Appendix C:**

Table 1	McGraw-Edison PCB Field Test Kit . . . . .	C-1
Table 2	Polychlorinated Biphenyl (PCB) Analysis of Soil . . . . .	C-2

### **Appendix D:**

Table 1	Results of Post-Cleanup Samples . . . . .	D-1
---------	---	-----

### **Appendix E:**

Table 1	LLNL Soil Sieve Analysis . . . . .	E-1
Table 2	Import Soil Sieve Analysis . . . . .	E-1

### **Appendix F:**

Table 1	Traffic Circle Sample and Analysis . . . . .	F-1
---------	--	-----

## **East Traffic Circle Landfill Closure Report**

### **Executive Summary**

This report presents the results of the investigation and cleanup of the East Traffic Circle Landfill (ETCL), an inactive landfill located in the east-central portion of the main site of Lawrence Livermore National Laboratory.

The old landfill site was uncovered by construction workers during utility-line trenching on July 19, 1984. The uncovered debris was surveyed with radiation detection instruments, showed no radioactivity, and was found to consist primarily of metal shavings and broken bottles. An initial soil sample was taken and analyzed for metals and volatile organic compounds. Only copper, lead, and zinc were detected in some samples at levels exceeding the state hazardous waste designations.

The U.S. Department of Energy, San Francisco Operations Office (DOE-SAN), and federal and state environmental regulatory agencies were notified of the discovery of the landfill and were subsequently apprised of the investigation workplan, findings, and the cleanup activities.

The landfill does not appear in aerial photographs taken when the Navy occupied the Livermore site (in the mid-1940s), but it does appear in the earliest LLNL photograph (1956) as a large depression with a road down to the bottom. The landfill was apparently in use until about 1970 when the area was returned to grade.

A records search was performed to determine the contents and boundaries of the landfill. Employee interviews revealed that the activities conducted in the area may have included:

1. The burning (in a burn cage) and burial of paper.
2. The burial of construction and metal debris (including metal shavings, copper wires, pipes, and miscellaneous equipment).
3. The disposal of capacitors, some containing polychlorinated biphenyls (PCBs).
4. The disposal of various drums (some of which may have contained chemical wastes).
5. The disposal of grass cuttings and gardening debris.
6. The disposal of sandblasting sand.
7. The disposal of bright dip (plating) tank contents.
8. Full-face breathing equipment training in a railroad car located in the north end of the area.
9. Storage of hydrocarbon fuel in above-ground tanks at the southern end of the landfill during the gas shortage in the late 1970s.

The boundaries of the landfill, reconstructed from surveyors' notes and aerial photographs, were verified in the field by careful trenching with a backhoe. Subsequent soil sampling by the use of backhoe trenching and boreholes defined those areas with copper, lead, and zinc contamination, areas containing construction debris (steel reinforcing bars, concrete, pipes, assorted metal straps, bolts, etc.), several areas with low levels of several radionuclides (radium from luminous dials for instruments, natural and depleted uranium, and others), and some areas with PCB capacitors and PCB-contaminated soil. The PCB capacitors were discovered during backhoe trenching in several areas where a magnetometer survey showed anomalies. Other magnetic anomalies were determined to have been caused by construction debris, underground utility lines, steel conduits, and culverts. Shallow soils generally showed little (less than 0.1 ppm) volatile halogenated and non-halogenated volatile organic chemical contamination; however, a sample collected beneath 20 partially crushed metal drums showed 11 ppm of trichloroethylene (TCE) and 50 ppm of tetrachloroethylene (PCE). Soils from 21 to 51 feet beneath the drums showed TCE and PCE concentrations approaching 1 ppm each.

During August and September 1984, the East Traffic Circle Landfill area was generally excavated to a depth of 5 to 7 feet below grade and to 10 or more feet in the vicinity of the 160-plus capacitors. The 13,971 cubic yards of excavated soil and debris were placed in segregated piles on 30-mil thick plastic, covered, and labeled as to waste type. In October 1984, following the post-excavation sampling of the site and approval by the California Department of Health Services (DOHS), the excavated area was backfilled and compacted to grade with a mixture of local and imported fill. In December, 1984, and January, 1985, over 8,000 cubic yards of the excavated PCB-contaminated soils were hauled from the LLNL site by registered haulers and disposed of at state-permitted hazardous waste disposal sites. By September 3, 1985, the last of the materials had been disposed of: 2,345 cubic yards were PCB contaminated, 11,626 cubic yards contained levels of copper, lead, and zinc that exceeded hazardous waste criteria set by the State of California. About 8 cubic yards contained traces of radioactivity and were drummed or boxed and sent to the Nevada Test Site for disposal.

Construction activities resumed in the area after the landfill was backfilled. Much of the area formerly occupied by the landfill will be covered with office buildings, roadways, parking lots, and landscaping. No impact on current or future land use is anticipated. Minimal impact on groundwater quality from the remaining metals is expected since they are relatively insoluble. Any impact of the landfill on groundwater quality is being investigated as part of the LLNL Livermore groundwater investigation and will be reported on separately.

## EAST TRAFFIC CIRCLE LANDFILL CLOSURE REPORT

### 1. Introduction

#### 1.1 General Site History and Characteristics

Lawrence Livermore National Laboratory (LLNL) occupies one square mile (2.45 square kilometers) on East Avenue, 3 miles (5 km) due east of the city of Livermore, California. The Laboratory is located in the east-central portion of the Livermore Valley and is constructed on a rather smooth, hard surface sloping downward toward the northwest. Two arroyos cross the site, Arroyo Seco on the southwest corner and Arroyo Las Positas along the northern boundary. The East Traffic Circle Landfill was located in the east-central portion of the LLNL site (see Fig. 1).



Figure 1. Location of the East Traffic Circle on the LLNL site (circa 1960).

Before World War II, the land was part of a ranch used for raising grain and grazing cattle. The U.S. Navy bought the property in 1942 and established a primary training base for pilots. From 1950 to 1954, California Research and Development, a subsidiary of Standard Oil, occupied the eastern portion of the site. The property was transferred to the U.S. Atomic Energy Commission in 1952 and established as the Livermore branch of the University of California Radiation Laboratory and later renamed the Lawrence Livermore National Laboratory (see Ref. 1).

The Laboratory employs about 8,500 people in a variety of research programs including nuclear weapons, controlled thermonuclear fusion, laser fusion, laser isotope separation, biomedical and environmental research, and the development of other energy resources.

## 1.2 Nature and Extent of the Problem

During trenching for a communications/power duct bank, construction workers uncovered landfill debris in the East Traffic Circle area on July 19, 1984 (see Fig. 2). The debris consisted primarily of metal shavings and broken bottles and showed no radioactivity when surveyed with radiation detection instruments. The initial soil samples were collected to be analyzed for metals and volatile organic compounds. Copper, lead, and zinc were detected in some of the samples at levels exceeding the State of California hazardous waste designations. No volatile organic or asbestos compounds were detected in these samples (Ref. 2).

LLNL decided to suspend construction activities in the landfill area until the landfill had been assessed and cleaned up. LLNL then commenced an immediate investigation and excavation (and, eventually, disposal) program for the hazardous materials (found to be mainly PCB capacitors and soil contaminated with PCBs and metals) in order to minimize the future impact of the landfill contents on human health, the environment, and future use of the area by the Laboratory for offices, roadways, parking lots, and landscaping.

A records search was performed to determine the contents and boundaries of the landfill. The landfill does not appear in aerial photographs taken when the Navy occupied the Livermore site (in the mid-1940s). The earliest LLNL photograph (1956) shows the landfill as a large depression with an access road down to the bottom and surrounded by an earthen berm about ten feet tall and a fence with an access gate on the west side. The area was returned to grade in about 1970. The Navy had a landfill on property now occupied by Sandia National Laboratory (SNL is adjacent to the southern perimeter of LLNL) and reportedly had a landfill on the LLNL site at the southwest end of the landing area (Ref. 1). Since the ETCL was located near the southeast corner, it seems somewhat unlikely that the Navy used the ETCL. From the records search and employee interviews it seems that California Research and Development used the landfill as a disposal site for chemical or other hazardous wastes.

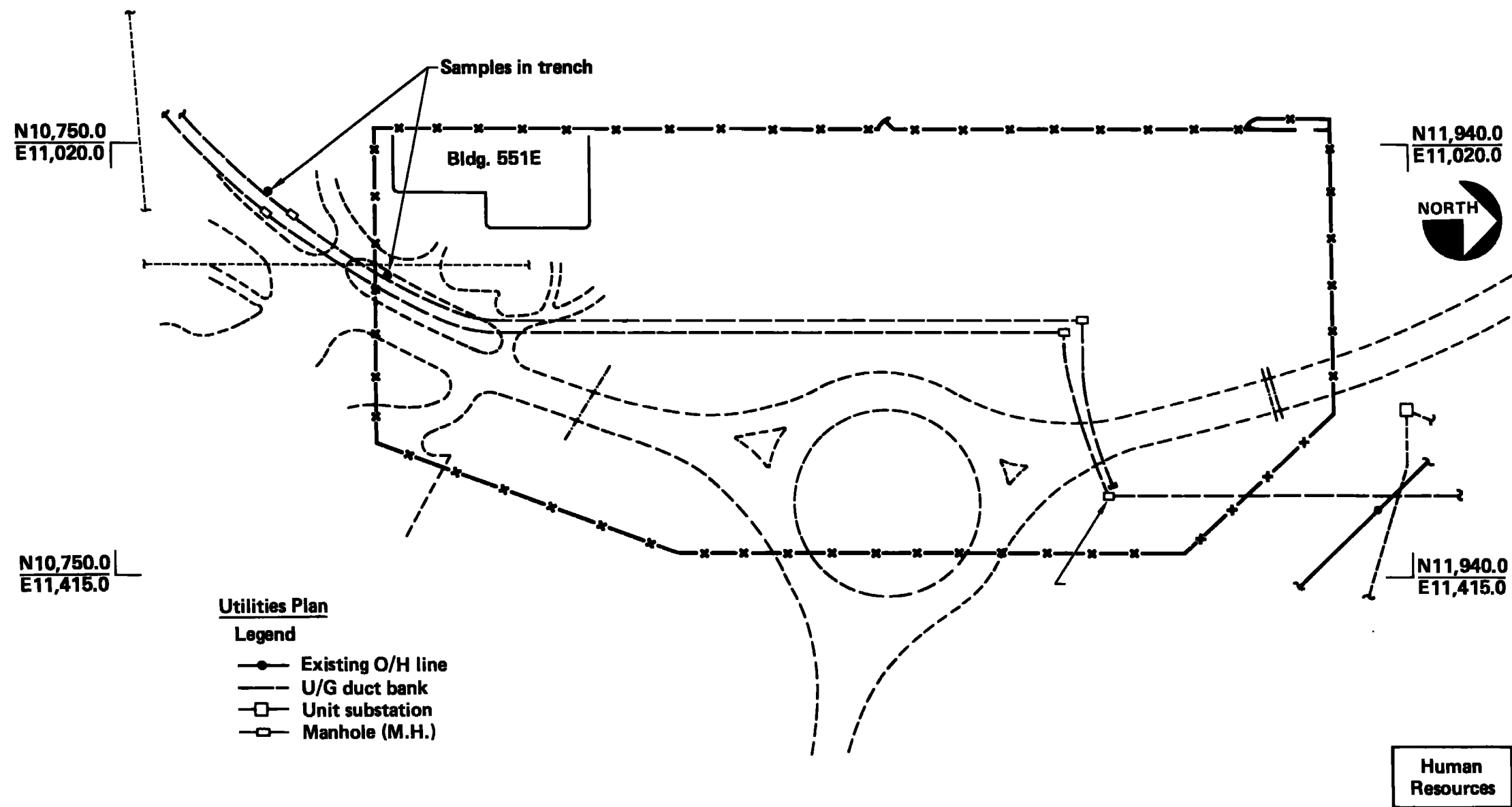


Figure 2. Utility lines passing through the landfill area.

The landfill was in use by LLNL until about 1970. Employee interviews revealed that the activities conducted in the area included:

1. The burning (in a burn cage) and burial of paper.
2. The burial of construction and metal debris (including metal shavings, copper wires, pipes, and miscellaneous equipment).
3. The disposal of capacitors, some containing polychlorinated biphenyls (PCBs).
4. The disposal of various drums (some of which may have contained chemical wastes).
5. The disposal of grass cuttings and gardening debris.
6. The disposal of sandblasting sand.
7. The disposal of bright dip (plating) tank contents.
8. Full-face breathing equipment training in a railroad car located in the north end of the area.
9. Storage of hydrocarbon fuel in above-ground tanks at the southern end of the landfill during the gas shortage in the late 1970s.

The landfill boundaries were reconstructed from surveyors' notes and aerial photographs and were verified in the field by careful trenching with a backhoe. The landfill covered an area of about 4.77 acres. Part of the western portion of the landfill area was already, at the time of the investigation, covered by Building 551. The southern portion of the landfill area was partially covered by parking lots. The problem then became the identification and excavation of any hazardous materials and soils found in the landfill area, the confirmation of cleanup by post-excavation sampling, the disposal of hazardous wastes, and closure/post-closure monitoring (Ref. 2 and 3).

### **1.3 Investigation Chronology**

<b>July 19, 1984</b>	<b>Construction workers uncovered first landfill debris.  Trench was surveyed for radioactive contamination.  First sample collected for analysis.  Decision is made to suspend construction activities in landfill area until an assessment of environmental hazards is completed.  The U.S. Department of Energy, San Francisco Operations Office, is notified of the discovery of the landfill.</b>
<b>July 23, 1984</b>	<b>Discovered first group of PCB capacitors.</b>
<b>July 24, 1984</b>	<b>Backhoed cross trenches along utility trench.  Established landfill boundry lines.</b>
<b>July 26, 1984</b>	<b>Submitted draft action plan to the Dept. of Health Services and Regional Water Quality Control Board.</b>
<b>August 1, 1984</b>	<b>Commenced excavation of landfill area.</b>
<b>August 1, 1984</b>	<b>Discovered first drum site.</b>
<b>August 6, 1984</b>	<b>Discovered second group of PCB capacitors.</b>
<b>August 27, 1984</b>	<b>Performed magnetometer survey of landfill.</b>
<b>August 30, 1984</b>	<b>Discovered second drum site.</b>
<b>September 19, 1984</b>	<b>Conducted post-excavation soil sampling.</b>
<b>September 22, 1984</b>	<b>Performed magnetometer survey of parking lot south-east of Building 551.</b>
<b>October 1984</b>	<b>Backfilled landfill excavation site with clean soil.</b>
<b>October 30, 1984</b>	<b>Submitted draft of landfill closure plan.</b>
<b>January 22, 1985</b>	<b>Removed over 1,000 cubic yards of PBC-contaminated soil from LLNL.</b>
<b>September 3, 1985</b>	<b>Completed removal of contaminated soil from LLNL.</b>
<b>September 10, 1985</b>	<b>Samples taken from under piles after pile removal.</b>
<b>September 25, 1985</b>	<b>Repeat magnetometer survey of parking lot E-4.</b>
<b>November 19, 1985</b>	<b>Resolved sources of magnetometer anomalies.</b>



## **2. Site Features**

### **2.1 Climatology**

The Livermore Valley is flat and roughly bowl-shaped, about 12.9 miles long and 4 to 6.7 miles wide, and surrounded by hills that are up to 975 and 1,950 feet high. The general area has a "Mediterranean scrub woodland" climate that is characterized by mild, rainy winters (about 15 inches of rain) from October to April and warm, dry summers. Sunshine is abundant throughout the year since the winter rains are of a showery nature. Snow is very rare. Winter storms are a result of migratory low-pressure systems that become detached from the semi-permanent "Aleutian Low" and move over or north of the area. Following the passage of the migratory low, skies typically clear as the "Eastern Pacific High" builds inland. Occasionally, under these conditions, strong northerly surface winds, with gusts up to 97.5 ft/s, are observed for a day or two. The summer is consistently warm and dry. A sea breeze typically develops during the afternoon when modified ocean air moves through the passes from the west; although the effect upon maximum temperatures is slight, the breeze persists into the early evening and brings cool nighttime temperatures. The strength of this sea breeze rarely exceeds 40 ft/s in Livermore. The spring and autumn seasons are typically transitional periods when no exceptional meteorological phenomena occur (Ref. 4).

### **2.2 Geology**

Recent geologic studies have led to the recognition of four geologic units within the late Tertiary-Quaternary sedimentary sequence that underlies the East Traffic Circle Landfill area. General descriptions of these (from oldest to youngest) are as follows (maps cited below are from Refs. 5 and 6):

**1. Lower Member Livermore Formation (Map Unit Tps - Ref. 6):**

Weakly indurated pebble conglomerate, sandstone, and greenish-gray claystone, materials grade blue in deep subsurface.

**2. Upper Member Livermore Formation (Map Unit Q+1):**

Dominantly red, orange, yellow, and brown gravel and silty, gravelly sand, lenticular interbeds of sandy silt, and silty clay.

**3. Undifferentiated Late Pleistocene Alluvial and Terrace Deposits (Map Units Qal1 and Qal2):**

Predominately light brown to yellow-brown silty gravel and silty, gravelly sand, lenticular interbeds of sandy silt and silty clay. Subdivided in surface exposures into two mapable units based on topographic position and soil profile development. However, these units cannot be distinguished in subsurface.

**4. Latest Pleistocene-Holocene Alluvial and Terrace Deposits (Map Unit Hpal):**

Dominantly dark brown to brown, organic-bearing silty clay and silt, local lenses of silty sand and gravel.

Boundaries between these four geologic units are difficult to identify because of the lithologic similarities among them. Increased induration of the presence of gray and green colors has permitted the identification of the Lower Member of the Livermore Formation in some deep observation wells and exploratory bore holes in eastern and southern LLNL (Ref. 6). However, the Upper Member of the Livermore Formation and undifferentiated late Pleistocene Alluvial and Terrace Deposits are the main geologic units beneath the East Traffic Circle area. The uppermost water-bearing zone occurs within these sediments (Ref. 3) and the Upper Member of the Livermore Formation has been separated from the overlying late Pleistocene Alluvial and Terrace Deposits based upon an apparent erosion surface detected during analysis of exploratory bore hole and observation well logs at LLNL. This boundary is not well defined in the vicinity of East Traffic Circle Landfill. In this vicinity, the last Pleistocene and Holocene sequences are restricted to a thin colluvial veneer consisting chiefly of dark brown silty clay. These materials thicken northeastward toward an ancestral channel of the Arroyo Las Positas, where they attain a thickness of about 10 feet.

The locations of 18 soil sampling holes and two groundwater monitoring wells (MW-104 and MW-16) in the vicinity of the East Traffic Circle Landfill are shown in Fig. 3. Their logs provide relevant geologic data. Subsurface data for the East Traffic Circle Landfill area is shown in Geologic cross-section A - A' and B - B' presented in Figs. 4 and 5, respectively. The locations of these sections are shown in Fig. 3.

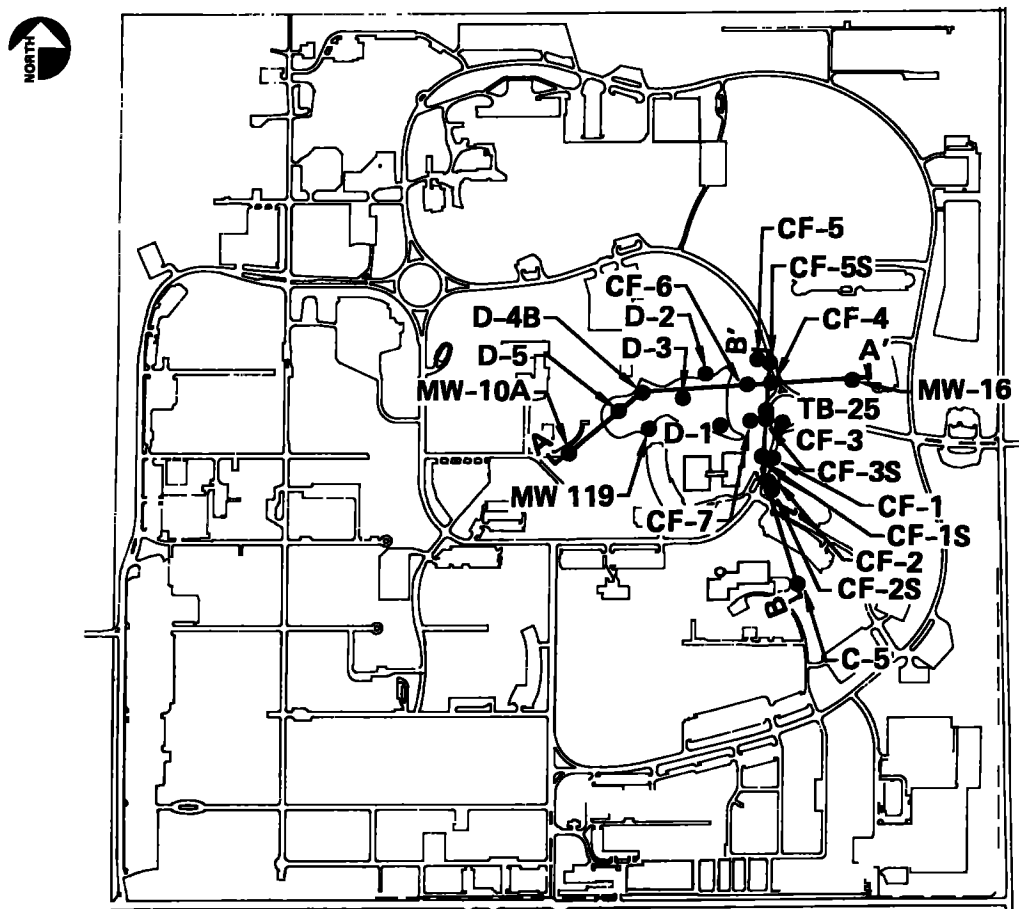
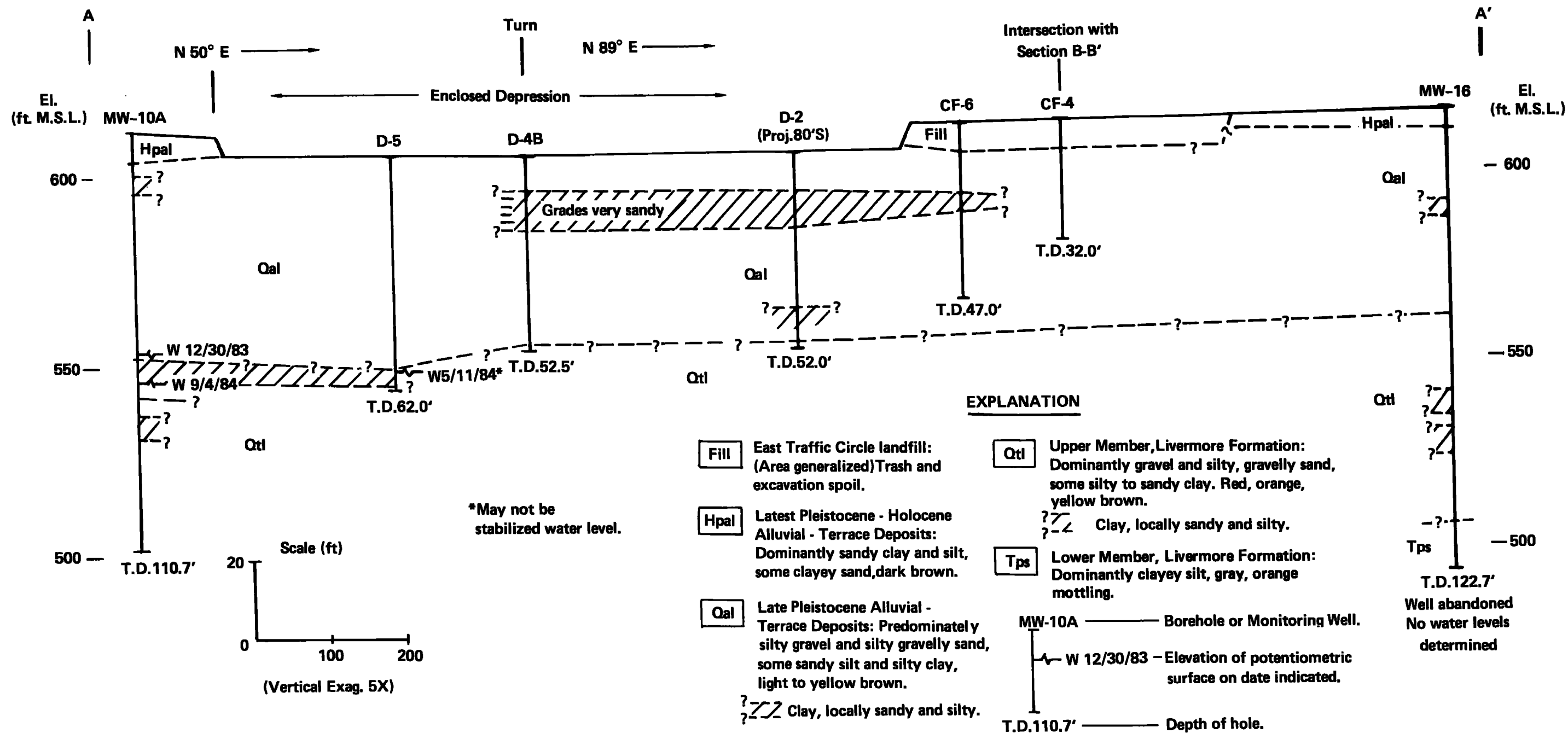
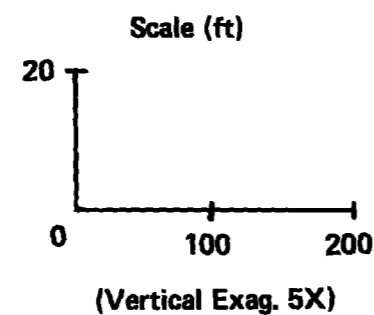
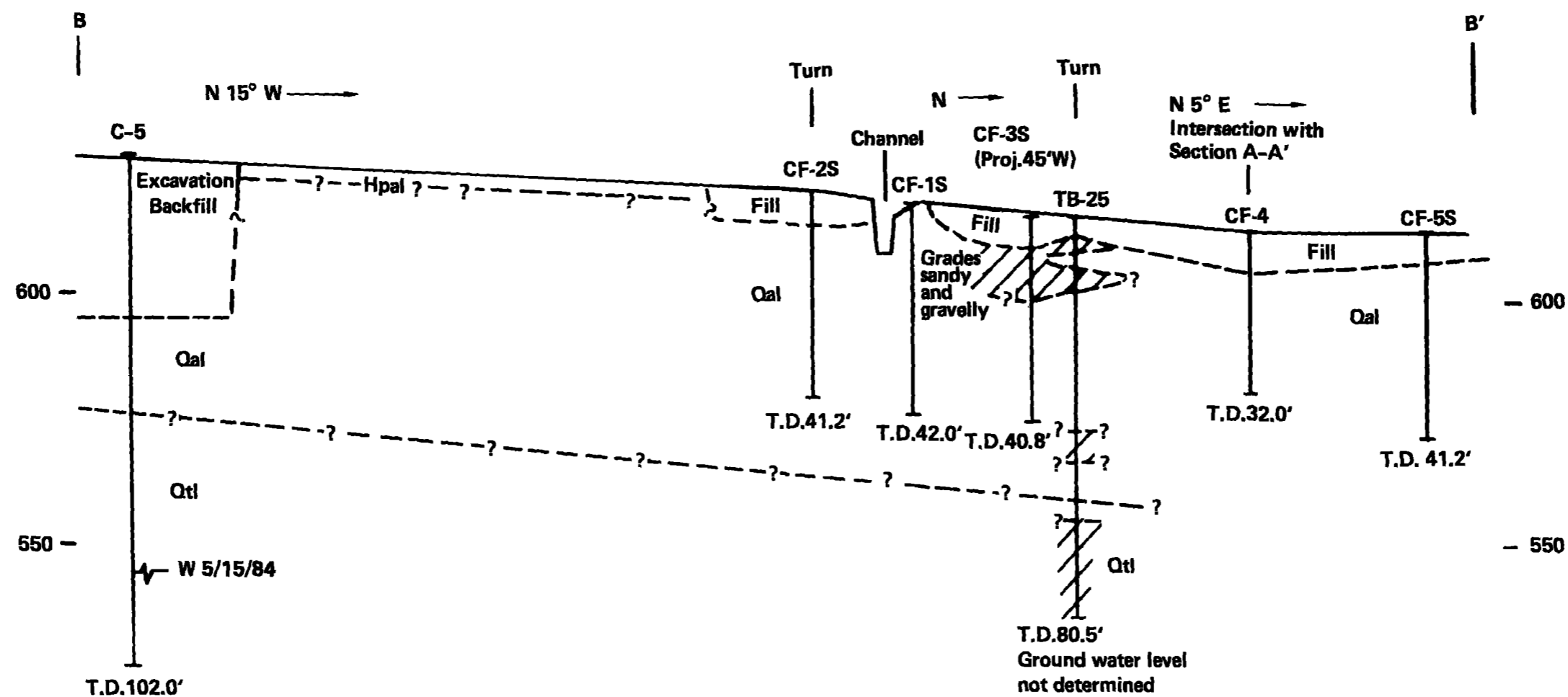


Figure 3. Locations of soil sampling holes.



**Figure 4. Geologic cross section.** This represents geologic survey trench A - A' located in Fig. 3.





#### EXPLANATION

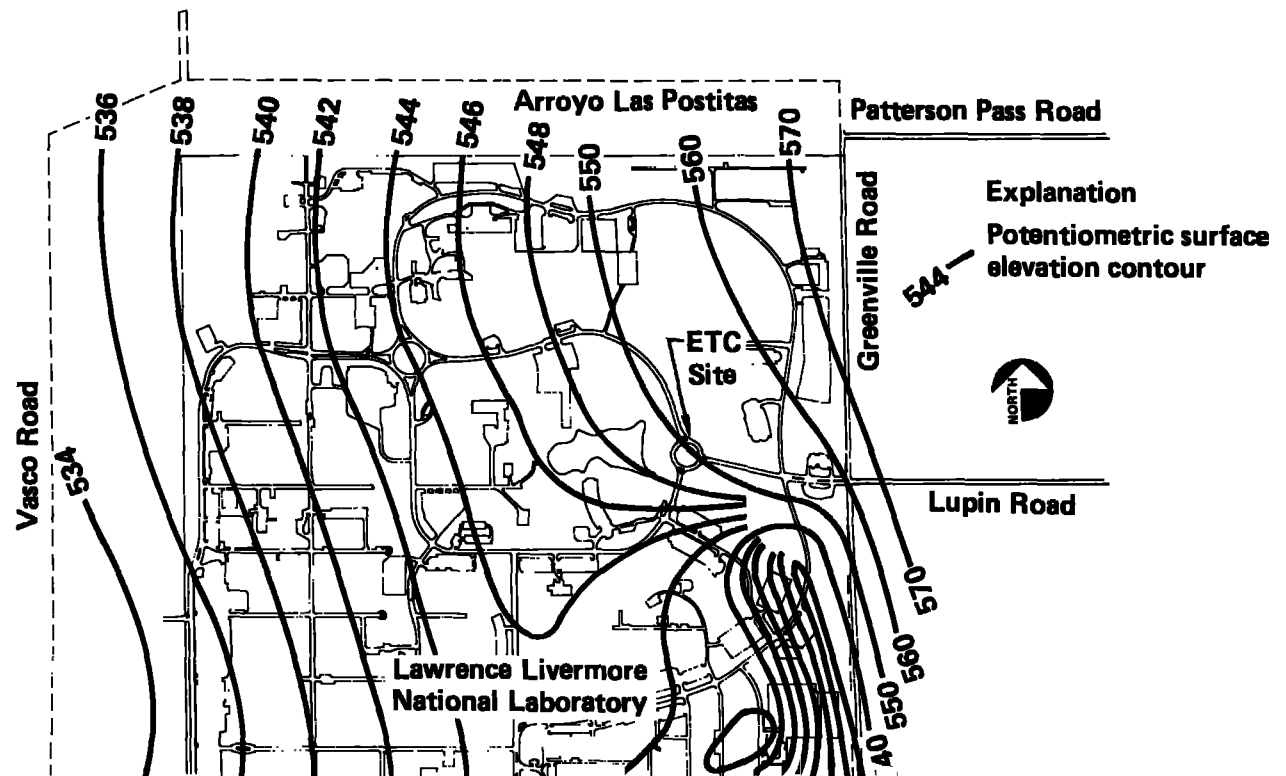
- |  |  |
|--|--|
| <p><b>Fill</b> East Traffic Circle landfill: (Area generalized) Trash and excavation spoil.</p> <p><b>Hpal</b> Latest Pleistocene - Holocene Alluvial - Terrace Deposits: Dominantly sandy clay and silt, some clayey sand, dark brown.</p> <p><b>Qal</b> Late Pleistocene Alluvial - Terrace Deposits: Predominately silty gravel and silty gravelly sand, some sandy silt and silty clay, light to yellow brown.</p> <p>? Z Z ? Clay, locally sandy and silty.</p> | <p><b>Qtl</b> Upper Member, Livermore Formation: Dominantly gravel and silty, gravelly sand, some silty to sandy clay. Red, orange, yellow brown.</p> <p>? Z Z ? Clay, locally sandy and silty.</p> <p>-- ? -- Approximate contacts between geologic units, queried where inferred.</p> <p>C-5 Borehole</p> <p>W 5/15/84 Elevation of potentiometric surface on date indicated.</p> <p>T.D. 102.0' Depth of hole</p> |
|--|--|

Figure 5. Geologic cross section. This represents geologic survey trench B - B' as indicated in Fig. 3.

As shown in the cross sections, materials encountered beneath the East Traffic Circle Landfill area consist chiefly of silty gravels and silty gravelly sands included with the undifferentiated late Pleistocene alluvial and terrace sequence and the underlying Upper Member of the Livermore Formation. Clay and clayey silt beds are locally encountered, but as shown in Section A - A' (Fig. 4), the lowest Member of the Livermore Formation was encountered at 100 foot depth in bore hole MW-16 located east of the landfill area. Materials encountered consisted dominantly of clayey silt with some silty sand.

### 2.3 Hydrology

Groundwater is present within the sedimentary sequence beneath LLNL (Refs. 7, 8, and 9). No well-defined areally extensive aquifers are present, but silty sand and gravel zones within the sediments yield up to a few gallons per minute to observation wells (Ref. 10). Figure 6 shows contours of the top of the potentiometric surface beneath LLNL and adjacent areas based on water level measurements made during the winter of 1983-84 (Ref. 11). Based on these contours, shown in Fig. 6, the winter 1983-84 potentiometric surface beneath the East Traffic Circle Landfill area was at a depth of about 65 feet.



Five groundwater observation wells exist in the immediate vicinity of the East Traffic Circle Landfill (only three are shown in Fig. 3). Three other wells (MW-119, MW-142, and MW-207) have recently been installed and additional new wells will be installed in that area (Refs. 8 and 9). This work is part of the LLNL Livermore Groundwater Investigation and is discussed briefly in Section 6. The nearest monitoring well, MW-142, is located in the traffic circle. All wells in the vicinity of the traffic circle monitor the first water-bearing zone. The water level of MW-142 fluctuates with the seasons. The second close-in monitoring well, MW-119, was installed between MW-10A and the landfill area. The third is located just south of the southern boundary of the ETCL. Groundwater observation well MW-10A has the most data regarding the hydro-geology for the landfill.

As discussed above, the average winter 1983-84 depth to water beneath the landfill area, based on aerial information, is about 65 feet. Water levels in monitoring well MW-10A show seasonal fluctuations superimposed upon an overall regional rising trend (Ref. 3). Figure 7 shows a hydrograph for well MW-10A for the period 1980-82 (from Ref. 3). Late winter peaks followed by declining levels during the spring and summer characterize water levels observed by this well. As shown on Section A - A' (Fig. 4), an elevated winter water level followed by a lower late summer level was detected when measurements were resumed in this well at the end of 1983. The late summer 1984 level was about 7 feet lower than the level measure on December 30, 1983.

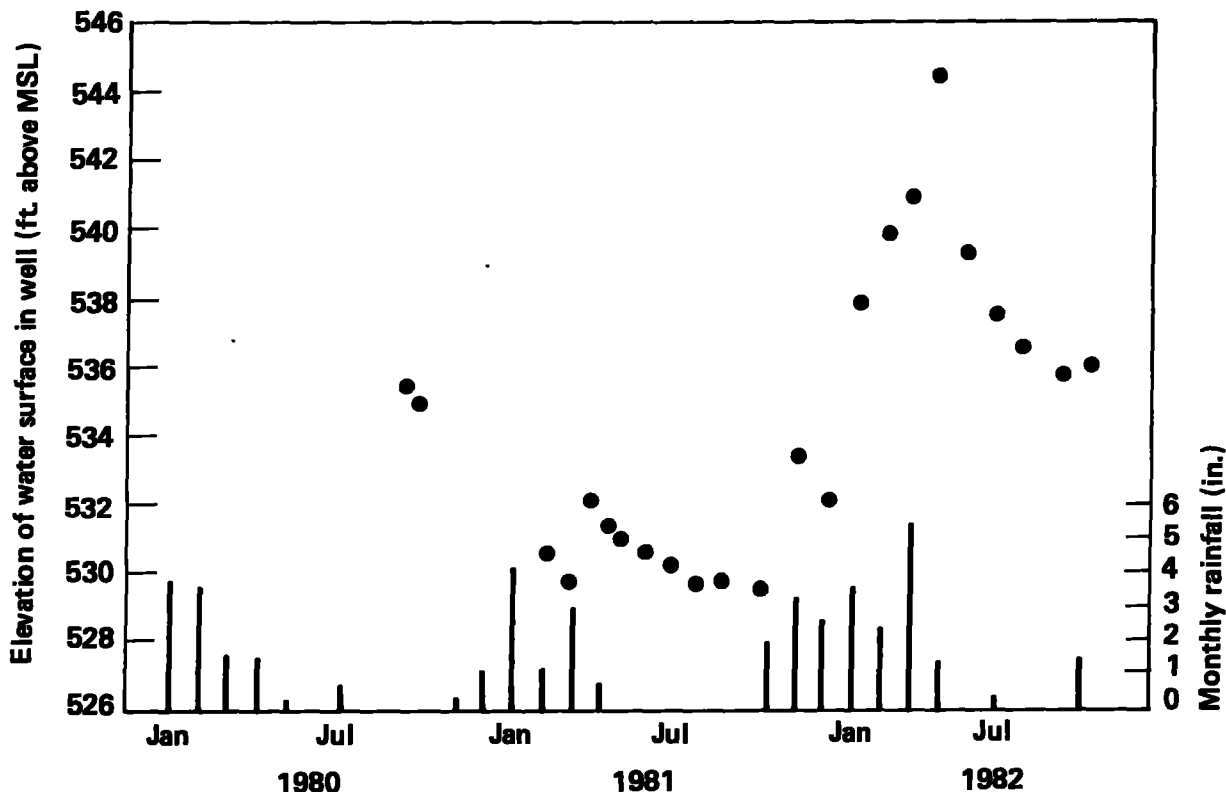


Figure 7. Hydrograph of monitoring well MW10A bailed dry on November 26, 1980. Location of MW10A is shown on Fig. 3.

Water levels fluctuate in well MW-10A in response to seasonal infiltration and recharge of water from the drainage-retention basin located west of the East Traffic Circle Landfill and northeast of MW-10A. Storm run-off from a large part of the southeastern portion of the LLNL site collects in the basin and remains ponded until infiltration and evaporation remove the water in late Spring (Ref. 10). A study is currently underway to determine and model the dynamics of groundwater recharge resulting from this ponding of storm run-off (Ref. 9).

Soil-moisture tritium profiles from abandoned well MW-16, located immediately east of the landfill, provides evidence that the well MW-10A water-level fluctuations are not caused by a high infiltration potential for alluvial deposits beneath the landfill area. Figure 8 (from Ref. 10) shows this data. A thorough discussion of  $^3\text{H}$  profiling and factors affecting  $^3\text{H}$  profiles at LLNL is contained in Ref. 10. Briefly, soil moisture data from abandoned MW-16 demonstrated that soil moisture derived from rainfall enriched with  $^3\text{H}$  did not penetrate beyond a depth greater than 23 ft (7 m), the shallowest sample analyzed for tritium. Since most  $^3\text{H}$  enrichment occurred during the period of major atmospheric nuclear weapons testing in the late 1940s and 1950s, this data suggests that the maximum vertical infiltration rate for rainfall did not exceed one foot per year in the vicinity of abandoned well MW-16 and may be significantly less.

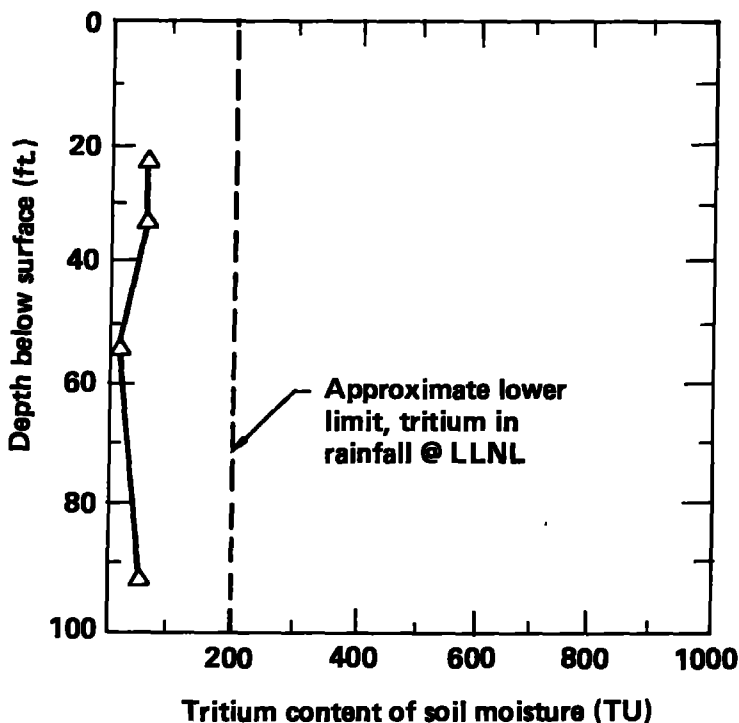


Figure 8. Soil tritium profile at monitoring well MW16. Water table estimated at 24 to 30 m (80 to 100 feet). Location of MW16 is shown on Fig. 3.

### **3. Methods**

#### **3.1 Backhoe Investigations**

A backhoe was used in the July 19, 1984 rediscovery of the East Traffic Circle Landfill and subsequently during the investigation of the landfill for several purposes. These included: exploratory trenching to verify the horizontal and vertical boundaries of the landfill; trenching to enable visual examination, logging, and sampling of the contents of the landfill and nearby soils; and for the removal of hazardous wastes and contaminated soils discovered in the area. Handling of contaminated materials is discussed briefly in Sections 3.6 and 3.7. Refer to Section 4 of this report for the locations of the backhoe excavations and discussions of the findings.

#### **3.2 Soil Borings**

During February, March, and May, 1984, over a dozen boreholes were drilled in the vicinity of the East Traffic Circle Landfill and sampled for volatile organics. This was done as part of the first phase of the LLNL Livermore Groundwater Investigation; the purpose of the first phase was to locate any potential sources of groundwater contamination by volatile organic hydrocarbons. Soil samples representing the top 27 to 32 feet of the soil column were collected by continuous coring. As part of the East Traffic Circle Landfill investigation, these cores were resampled and analyzed for metals, fluorides, and PCBs.

Additional boreholes were drilled during the period of September 19 - 21, 1984, to enable soil-column logging and sampling at various depths with a Split Spoon Sampler. The sample collection, handling, and preservation are described below. The sampling locations and results can be found in Sections 4.2 and 4.3.

#### **3.3 Sample Collection, Handling, and Preservation**

Samples of the landfill wastes and soil were obtained from trenches, boreholes, and the segregated piles of excavated material. Samples were collected using these three techniques: in stainless steel or brass core sleeves by pushing a clean sleeve directly into the materials manually or with a hammer; in core sleeves driven into the soil in a Split Spoon Sampler; and "manually" with a cleaned shovel or spatula.

The techniques used in sample packaging and preservation depended on the types of analyses to be performed. Samples to be analyzed for metals, fluorides, asbestos, and PCBs were packaged in either core sleeves (the ends of the sleeves were covered with aluminum foil and tape) or in glass jars, and then labeled, documented on chain-of-custody forms, and shipped to the appropriate analytical laboratory. Samples collected for purgeable priority pollutant analysis were carefully and quickly sealed in their core sleeves with aluminum foil and tape, or transferred to and tightly packed in 40-ml VOA (volatile organic analysis) vials. Samples were then labeled, documented on chain-of-custody forms, and refrigerated until delivery to the appropriate laboratory.

### **3.4 Analytical Procedures**

The wastes and soils were analyzed in the field and in the laboratory for radioactivity, metals, asbestos, fluorides, and PCBs by the semi-quantitative and quantitative techniques discussed below.

#### **3.4.1 Radioactivity**

Field radiation detection instruments were used to analyze for radioactivity in the trenches, samples, and excavated materials. An Eberline E-120 radiation detector with an HP 20 pancake probe was used to analyze for alpha, beta, and gamma emitting radionuclides. A FIDLER (Field Instrument for Detection of Low Energy Radiation) detector with a sodium-iodide crystal (which detects low energy photons and gamma radiation) was used to analyze for Americium-241 and, indirectly, the isotopes of plutonium.

Soil samples that showed some radioactivity according to the field instruments were dried and subjected to pulse-height analysis (PHA; isotopic identification and quantification) using a Gamma-X Detector. This detection system is sensitive to low-to-high energy x rays and can detect uranium, thorium, radium, americium, fission products, and other radionuclides.

#### **3.4.2 Metals**

Metals analyses were performed in-house at LLNL and at an independent state-certified analytical laboratory, Brown and Caldwell Analytical Services, by two techniques. Atomic absorption spectroscopy (AA) was used in both laboratories to quantitatively determine the metal Total Threshold Limit Concentrations (TTLCs). X-ray fluorescence was used to semi-quantitatively determine the metal TTLCs. The x-ray fluorescence technique was preferred over analysis by AA because the technique was quicker, less costly, and the samples required less preparation and remained intact.

For quality-assurance purposes, some split samples were submitted to both the in-house and the Brown and Caldwell laboratories for metal TTLCs analyses by the AA technique at both laboratories and by x-ray fluorescence at LLNL. Selected split samples were also analyzed at Brown and Caldwell for their Soluble Threshold Limit Concentrations of metals to determine the TTLC vs STLC relationship.

#### **3.4.3 Asbestos and Fluorides**

Selected samples were analyzed microscopically for asbestos at both LLNL and Brown and Caldwell. Selected samples submitted to Brown and Caldwell were also analyzed by standard methods for fluorides.

#### **3.4.4 PCBs**

Samples from the investigation and excavation phase of this project were analyzed for PCBs by standard methods at both LLNL and Brown and Caldwell. PCB analyses were also performed in the field with a portable PCB analyzer by the U.S. Environmental Protection Agency Field Investigation Team (FIT) and similarly by LLNL after acquiring a portable PCB analyzer.

When the PCB-contaminated soils were ready to be transported off site for disposal, the state-certified hauler/disposer (IT Corporation) performed additional PCB analyses in their own analytical laboratory.

#### 3.4.5 Mobility of Metals - Soil pH and Cation Exchange Capacity (CEC) Analyses

The mobility of metals in the geosphere is largely a function of the partitioning of metal between the solution and particulate phases (Refs. 12 and 13). The partitioning of heavy metals between solution and particulate phases is strongly influenced by solution pH. The presence of complex forming species such as sulfates and carbonates also aids in the precipitation of many cations such as chromium, nickel, zinc, copper, and cadmium. In general, higher pH results in greater adsorption and precipitation while lower pH results in less adsorption and precipitation.

The sorptive capacity of the soil, which is a factor of the chemical species present, can collectively be labeled the Cation Exchange Capacity (CEC) or Cation Adsorption Capacity. Cations are bound to negatively charged sites on soil particles through electrostatic bonding. Usually, trivalent and divalent cations are more tightly held than monovalent cations. The soil pH and available surface area are factors affecting CEC. Generally, clays have large surface areas and high CEC, while sand, being relatively low in surface area, is usually low in CEC. A measurement of CEC can be obtained to give an estimation of the ability of the soil to sorb and retain pollutants. This is usually expressed in meg/100 grams of soil.

Soil pHs were measured on slurries of selected soils. The CECs were determined on selected soil samples by: saturating the available binding sites in the soil with an ionic compound, elution of that ionic compound from the soil, and quantitative analyses of the elutant.

#### 3.4.6 Soil Sieve and Proctor Density Analyses

Soil sieve and proctor density analyses were performed by ASTM standard methods on LLNL and import soils to determine the approximate soil density and permeability that would be attained in backfilling the excavated portions of the landfill.

### 3.5 Geophysical Investigations

#### 3.5.1 Magnetometer Surveys

The landfill area and the region between the landfill and the taxi strip located to the south (a former low-level radioactive waste storage area) were surveyed with a magnetometer in a noninvasive attempt to locate and define any additional buried metallic objects (i.e., capacitors, drums, pipes, tanks, and utilities) not already uncovered by the excavation of the northern half of the landfill site. The area south of the East Traffic Circle Landfill had not been used for disposal according to employees familiar with the landfill operations. The southern portion of the surveyed area was largely covered with landscaping, roadways, and parking lots.

Magnetometer surveys were performed using a Geometrics Model G-816 proton-precision magnetometer in September 1984, and on September 28, 1985. Magnetometers detect variations in the total intensity of the earth's magnetic field, permitting detection of the metals (Ref. 14). Discrete (as opposed to continuous) measurements were taken every ten feet.

On November 6, 1985, LLNL used a Heliflux Magnetic Locator (model GA-2) to pinpoint the anomalous areas for exploratory excavation.

### 3.5.2 Electromagnetic or Conductivity Survey

In an attempt to noninvasively resolve the anomalies indicated by the magnetometer surveys, LLNL performed an electromagnetic or conductivity survey on October 2, 1985, using a Geonics (EM34-3) meter. Electrical conductivity is a function of the type of soil and rock, its porosity, and permeability of the fluids that fill the pore space. Conductivity surveys can be used to assess natural (shallow) hydrogeologic conditions, locate burial trenches, map shallow plumes, and to locate buried pipes and other discrete objects (Ref. 14). Discrete measurements were taken every ten feet and the transmitter-to-receiver distance was kept fixed at 30 feet.

### 3.5.3 Resolution of the Geophysical Anomalies

Three of the anomalies detected by the geophysical surveys were not resolvable by reviews of surveyor's logbooks, utility plans, and "as-built" construction diagrams. These three anomalies, located in the parking lot southeast of Building 551 and south of the East Traffic Circle were carefully excavated with a backhoe so that the causes of the anomalies could be determined.

## 3.6 Excavation, Storage, and Disposal of Wastes and Contaminated Soil

The discovery of the landfill and its boundaries was initially done using a backhoe. Since the contaminated layer varied in depth from a few inches to four or five feet, the overlay material had to be removed using heavy equipment. Backhoes were used for exploratory trenching and some waste removal. Bulldozers were also used to excavate and remove wastes and soil. During removal operations, the area was kept damp to minimize additional spreading. The waste and contaminated soil were removed to a temporary storage area by trucks, put in separate piles on 30-mil synthetic sheeting and later covered to prevent run-on, run-off, and wind dispersal (Fig. 9).

PCB capacitors were temporarily put on plastic sheeting and then loaded into drums, sealed, and moved to the Building 625 PCB Waste Storage Facility and stored until disposal.

All waste material containing metals exceeding the state action level was shipped to a state-approved Class I disposal site. Contaminated soil with less than 50 ppm of PCB was sent to a state-approved PCB landfill. PCB-contaminated soil exceeding 50 ppm was shipped by IT Corporation to Beatty, Nevada.



**Figure 9. Excavated soil placed on 30-mil synthetic base.**

### **3.7 Health, Environmental, and Safety Procedures**

The East Traffic Circle Landfill sampling, exploration, excavation, and disposal operations were monitored on a daily basis by a health and safety technician under the direct supervision of a professional environmental engineer, industrial safety engineer, an industrial hygienist, and a health physicist, all located on site. Based upon recommendations by these professionals, workers were protected from contamination by the use of disposable coveralls, gloves, and appropriate respiratory protection. Furthermore, excavation and recovery operations were carried out under the guidelines of the LLNL Hazards Control Manual and the LLNL Health and Safety Manual.

### **3.8 Decontamination of Equipment**

Excavation equipment was decontaminated by swabbing all PCB contact surfaces with hexane until less than 50 ppm were detected. Solvent-impermeable gloves were used and swab material was disposed of according to 40 CFR 761.79 (a).



#### **4. Results and Discussion**

##### **4.1 Backhoe Investigations**

During trenching for a communication/power duct bank, construction workers uncovered landfill debris on July 19, 1984, in the vicinity of the East Traffic Circle. The debris consisted primarily of metal shavings and broken bottles and showed no radioactivity when surveyed with radiation detection instruments. A soil sample was collected from the bottom of the hole, as described below in Section 4.3, and showed copper, lead, and zinc in quantities above the state hazardous waste limits (see Table 1 in Appendix A). This utility trench essentially marked the beginning of the East Traffic Circle Landfill investigation. Subsequently, exploratory trenching (backhoe investigation) was performed to:

1. Verify the landfill boundaries,
2. Enable visual examination (including inspection for darkened or stained soil horizons, logging, and sampling of the landfill contents and contaminated soils), and
3. Remove hazardous materials and soils as they were encountered.

To establish the boundaries of the old landfill (see Fig. 11, trenches C-1 through C-25), short trenches (5 to 10 feet in length) were excavated. These trenches were excavated with a backhoe to a depth at least 1 foot beyond where any landfill debris was encountered. Typically they were 5 feet deep, many were as deep as 10 feet. The results of this visual examination correlated closely with aerial photographs, the recollections of long-term employees associated with the laboratory, and surveyors' notebooks.

The trench soil profiles were examined for traces of landfill debris or darkened soil horizons, which would indicate possible hazardous waste. A definite layer of waste material was identified in many of the trenches. The waste was confined to a single layer a few inches to 2 feet thick and no more than 4 feet below the surface. The only exception was a thick layer of sand that was exposed at the 5 foot depth in trenches C-1 and C-2 (Fig. 11). It was speculated that this may have resulted from a sandblasting operation at that site several years before and may have a high concentration of lead. However, high levels of lead were not found.

The southern boundary lies within an area that is developed with landscaped lawns and parking lots. This area was visually examined as the power and communication duct banks were being installed. A trench was excavated to 10 feet below grade starting southwest of the landfill and proceeded northeast through the landfill. This excavation showed no visual signs of debris until the area north of Building 551. Samples were taken at the two locations indicated in Fig. 2 and analyzed for heavy metals by x-ray fluorescence. Only trace amounts of zinc, copper, lead, and gallium were detected.

X-ray fluorescence was used as a screening tool. It was faster and less expensive than a full laboratory analysis and gave a reliable indication of the relative amount of metals in the sample. It was established that a

"medium" or "high" level of metals is equivalent to the level that would be considered hazardous waste by the California Department of Health Services. Locations of sample numbers A1 through D12 are found in Fig. 11. Samples RW1 through RW6 and RW13 through RW18 are found in Fig. 13. Results for the analysis of these are found in Table 2 of Appendix A.

Preliminary analysis for total heavy metals was performed by x-ray fluorescence and atomic adsorption at LLNL. General patterns were seen to emerge from these analyses. Areas northeast of the traffic circle contained waste that exceeded the CAM TTLCs for lead, copper, and zinc. Areas northwest of the traffic circle and north of Building 551 did not exceed the levels for the CAM metals except for copper in two trenches. In addition, trenches that appeared not to contain any debris or noticeably discolored soil profiles did not have metals concentrations exceeding the TTLCs.

Locations that had field-instrument-measurable radioactivity were sampled and analyzed by PHA. The results are listed in Table 3 of Appendix A.

During backhoe investigations, approximately 160 capacitors were located and removed. The capacitors were placed on a 30-mil poly-vinyl sheeting and each capacitor was tested for PCBs (see Fig. 10).



**Figure 10.** Capacitors removed during backhoe investigations. Capacitors were placed on 30-mil poly-vinyl sheeting and tested for PCBs.

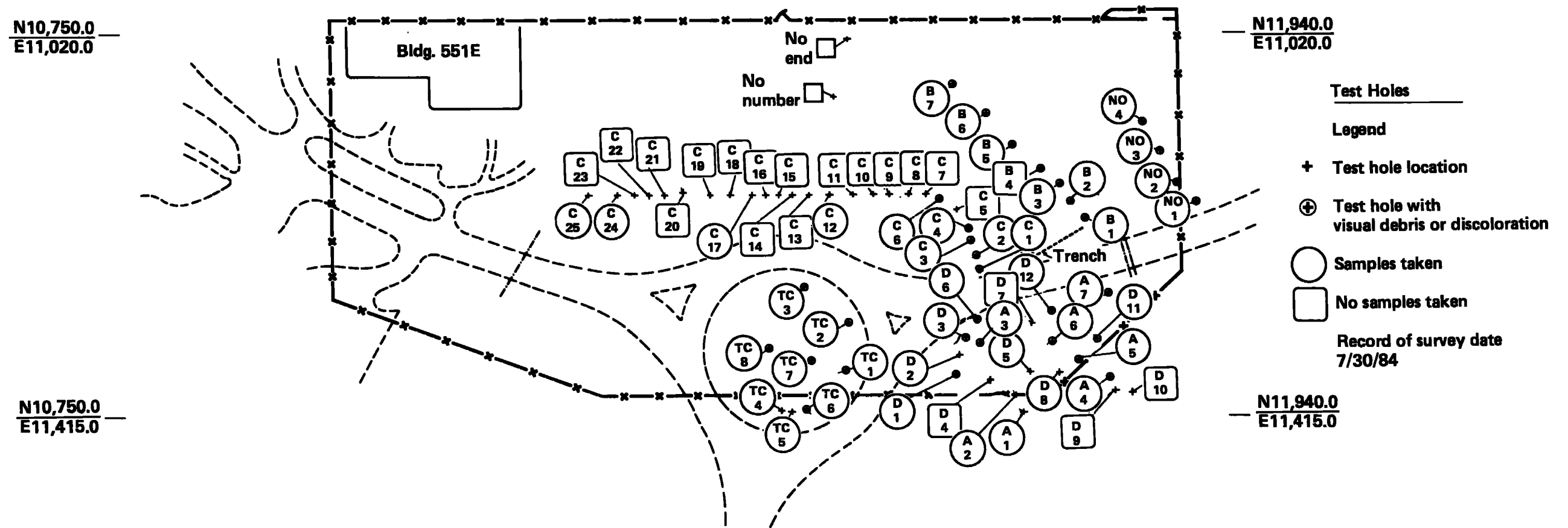


Figure 11. Locations of short trenches and test holes.

•





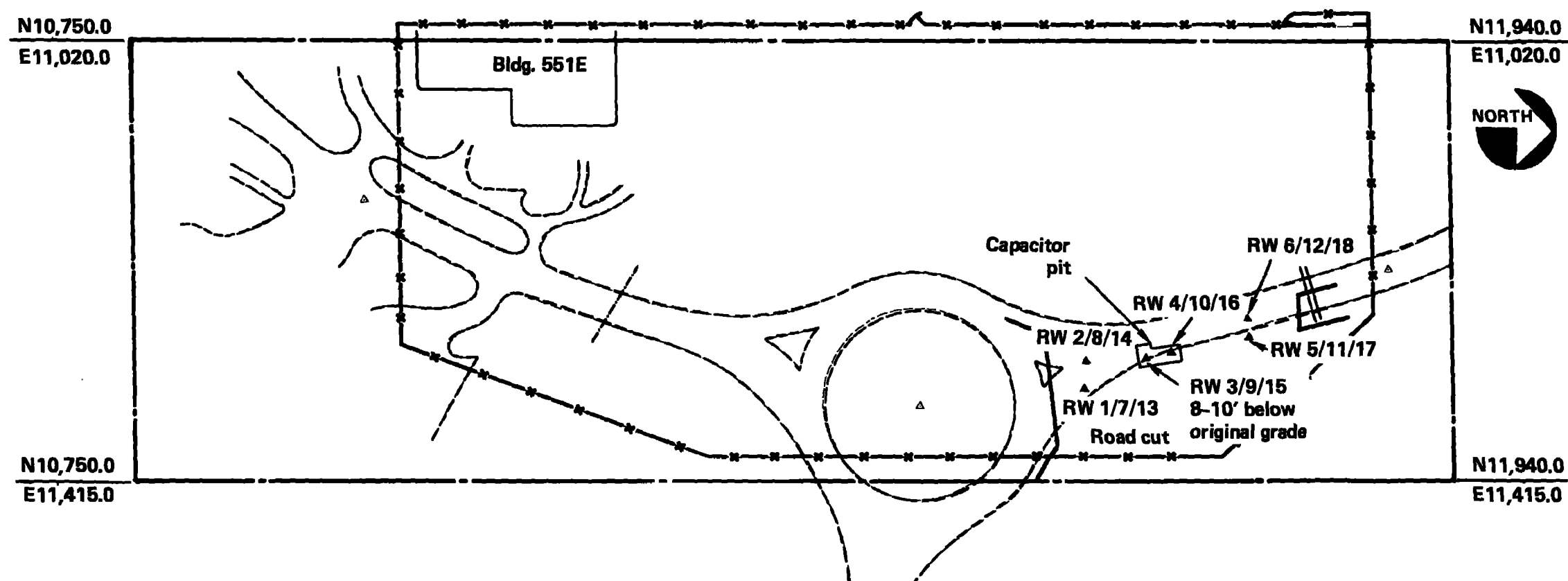


Figure 13. Locations of samples analyzed by x-ray fluorescence (see Table 2, Appendix A).

#### **4.2 Descriptions and Locations of Waste Types**

The East Traffic Circle Landfill waste types and their locations, as determined by the backhoe investigations, soil borings, excavation, and chemical analyses, are summarized and briefly discussed in this section. Figure 15 shows the approximate extent of each of these areas within the East Traffic Circle Landfill. Figure 21 shows the excavated area.

**Area 1.** Metal shavings, broken laboratory bottles, fiberglass filaments, fabrics, discolored soil layers. Waste was confined to a single layer from a few inches to 2 feet thick with the bottom of the layer no more than 5 feet below the ground surface (see Fig. 14). During the course of excavation and removal, this type of waste seemed to extend throughout the areas shown in Fig. 15. Most of the low-level radioactivity, discussed in Section 4.1 and quantified in Appendix A Table 3, was found in Areas 1 and 3.

**Area 2.** Some large metal turnings, copper pipes, iron pipes, lesser concentrations of Area 1 debris, some rusted crushed drums.



**Figure 14. Layer of waste fragments within 5 feet of the ground surface.**

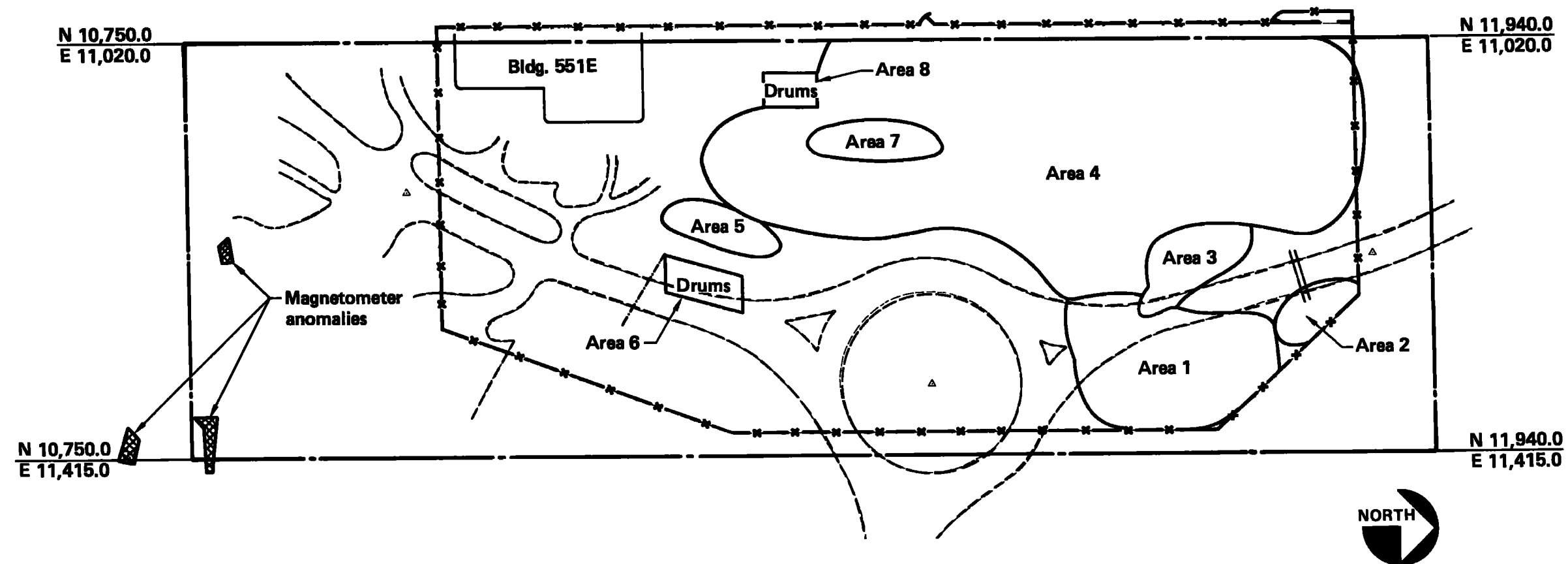
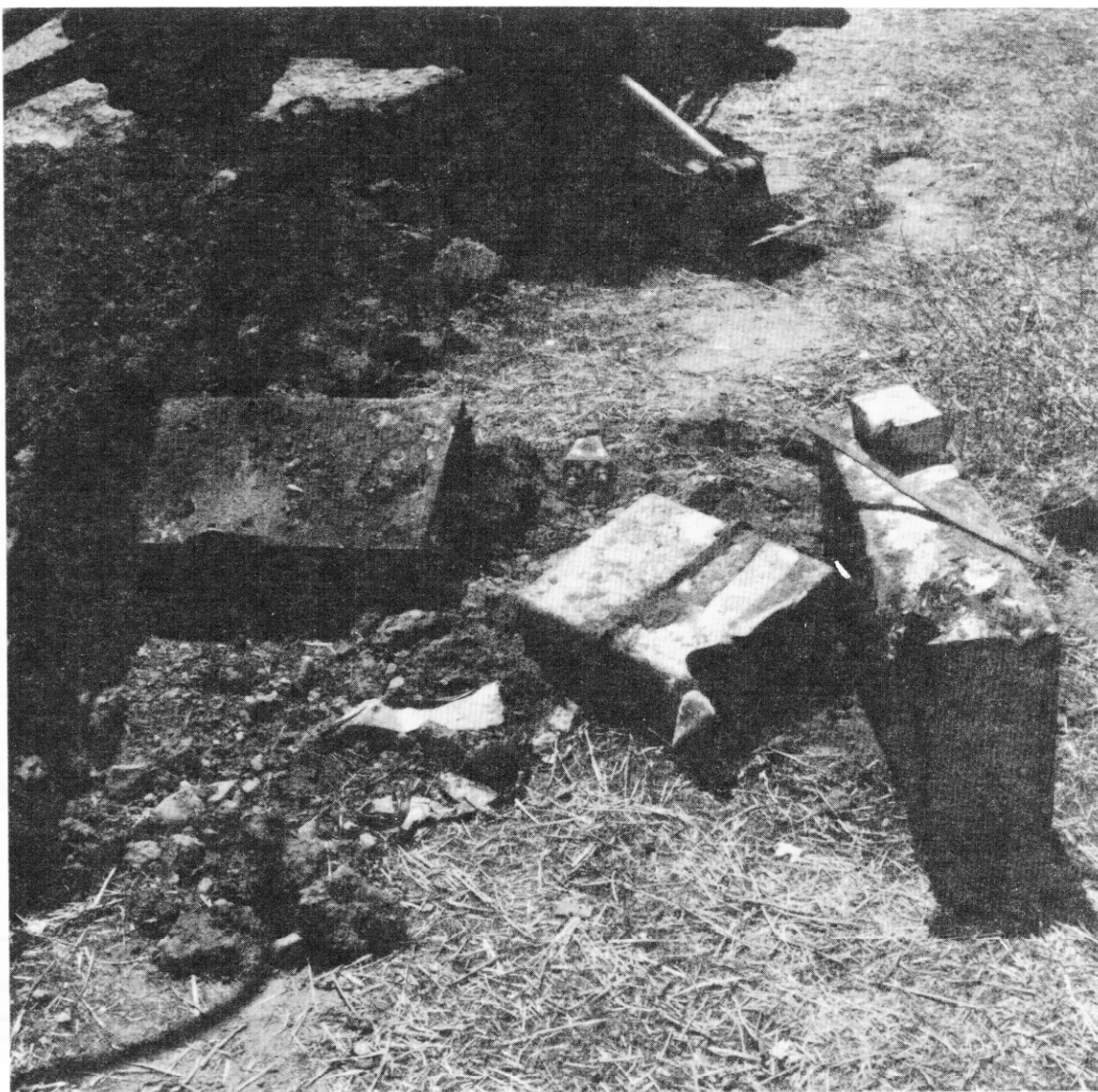


Figure 15. Locations of waste areas.



**Figure 16. PCB capacitors discovered early in the investigation.**

**Area 3.** PCB capacitors only; no other waste types. Approximately 160 capacitors were found and removed. Most of the capacitors appeared to have been intact and not leaking prior to their exhumation. The backhoe and bulldozer discoveries of these capacitor caches caused the breaching of some capacitors and the generation of more contamination for removal. All were in three definite caches, arranged randomly as if they were dumped from a truck. Except for a few, all were General Electric models measuring approximately 8 x 18 x 24 inches (Fig. 16 above). Approximately 10 were hand-size Cornell Dubblers.

Area 4. Low concentrations of metal shavings, discolored soil, a few scattered crushed drums, copper and iron pipe, some broken glass. The debris layer varied in thickness from a few inches to a few feet. The top of the layer was very close to the surface.

Area 5. Paper trash pile a few feet below the bottom of the arroyo - mostly computer printouts and IBM cards. Figure 19 shows the location of the two drum areas and an old waste pit. The pit was discovered in a records search and the exact coordinates were located by LLNL surveyors. A scan for metals was made at 8 and 12 foot depths and results showed only traces of Zinc, Copper, and lead. The first drum site discovered 8/1/84 contained 4 drums that were uncrushed but in badly corroded condition. Two drums were empty (see Fig. 17) while one drum contained the epoxy resin DER332 (see Fig. 18 and 20). The fourth drum contained a very small amount of a muddy water. The muddy water contained detectable levels of volatile and semi-volatile compounds (see Table 4, Appendix A). The surrounding soil was analyzed for the 8240/8270 compounds with negative results.

Area 6. Included automobile oil and air filters.

Area 7. Grass clippings from 2 to 4 feet below the surface (partially decomposed). The second drum site discovered 8/30/84 resulted in about 20 drums being removed. Most of the drums were empty and partially crushed. A few contained a very viscous terpene-type fluid. The surrounding soil contained detectable levels of volatile and semi-volatile compounds (see Table 6, Appendix A). This area was completely excavated and stockpiled until disposal could be arranged.

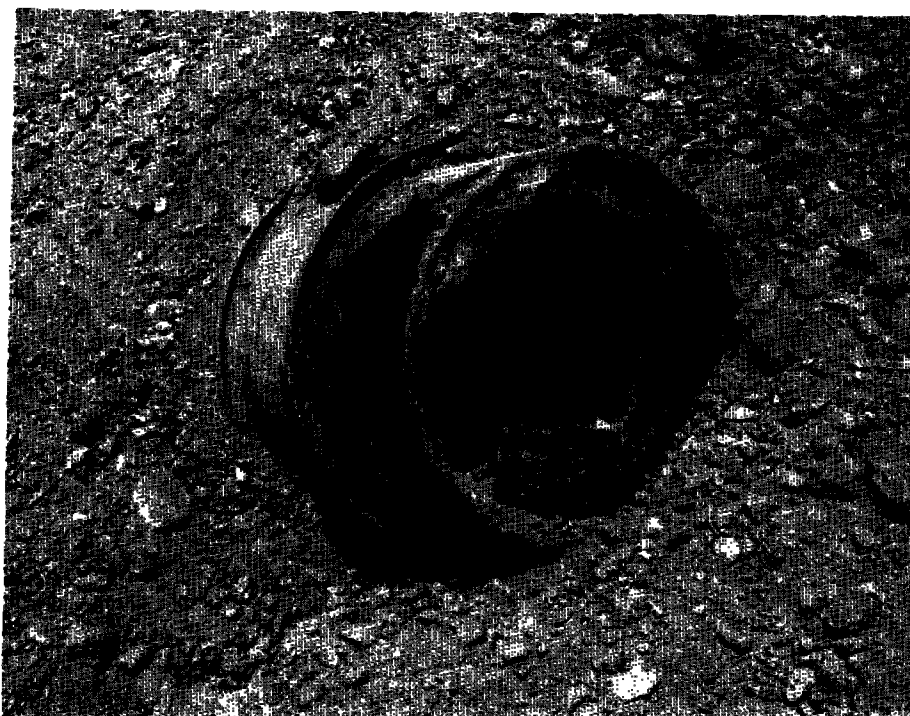
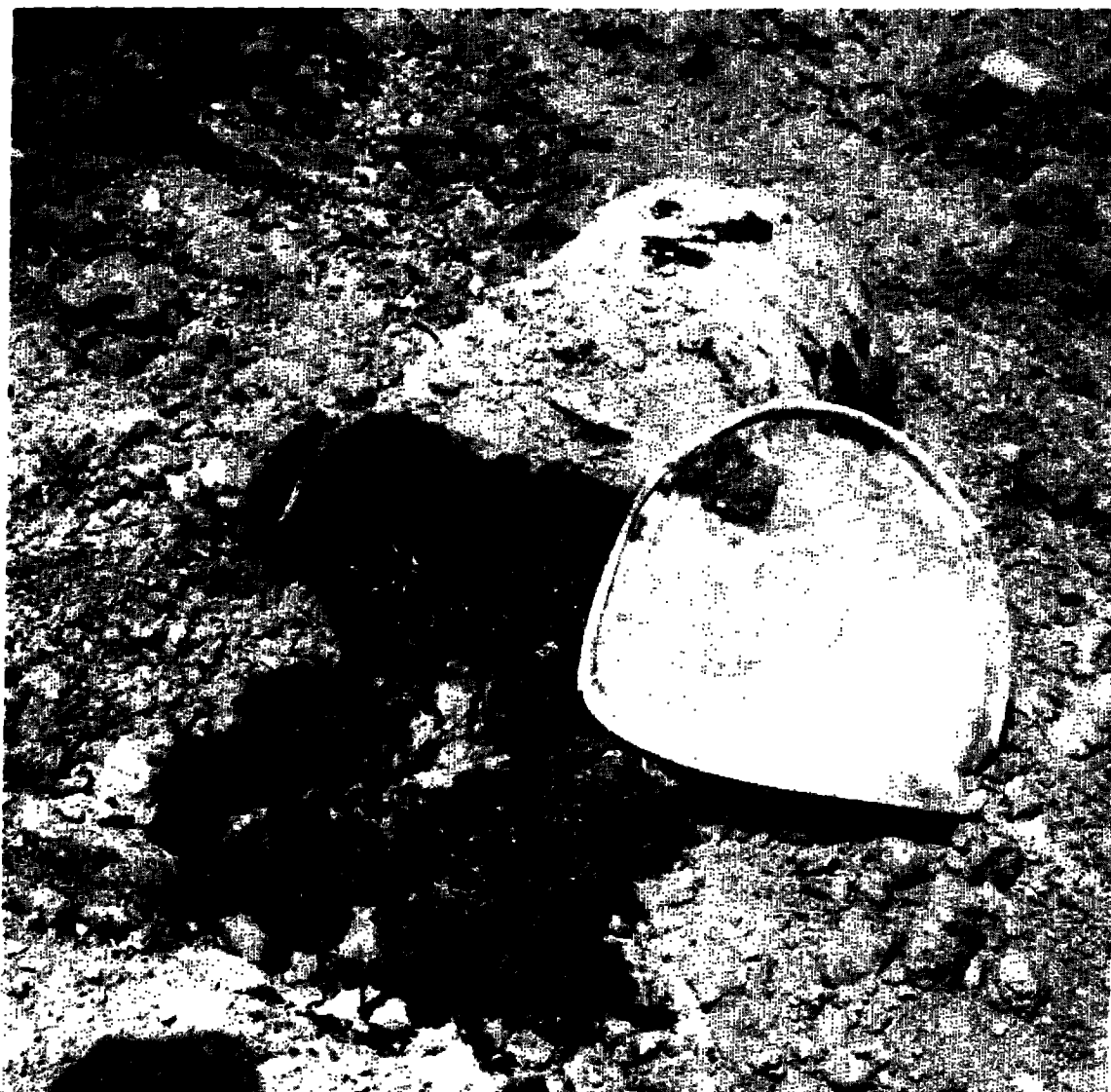


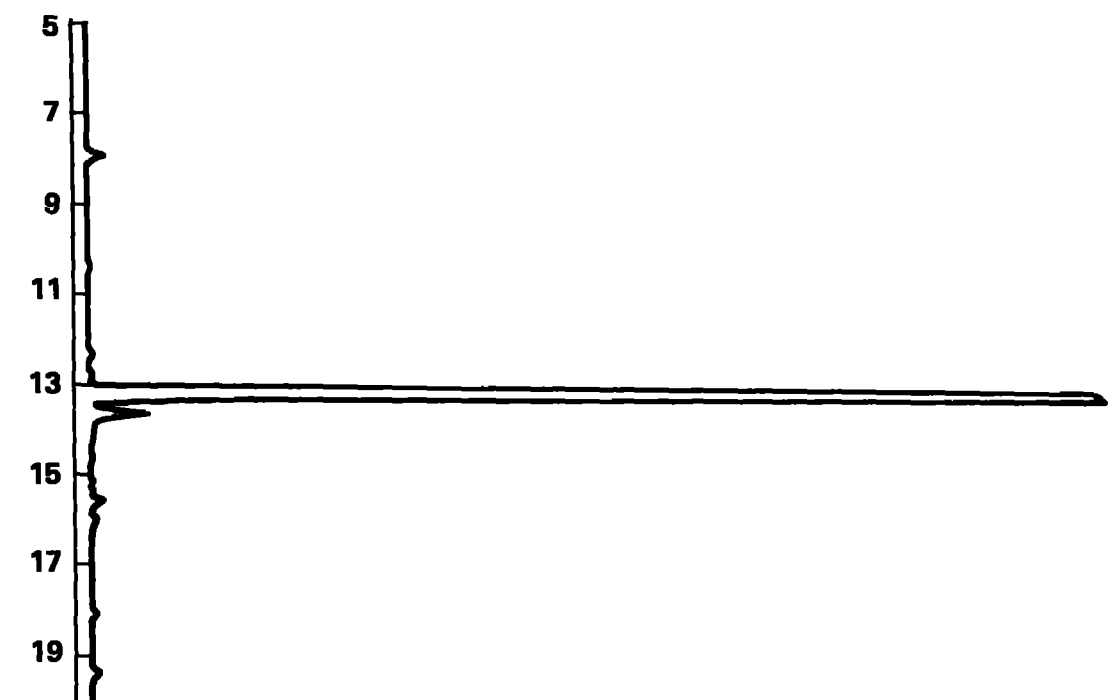
Figure 17. Example of empty drums found during excavation.



**Figure 18. Drum containing epoxy resin DER332 uncovered during excavation.**



Sample: DER332 STD Injected: 13:04:10 on Aug. 22, 1984  
Raw: R52351 Enlarged X 1  
Plot: 5 to 20 min.



Sample: Dump DER? Injected: 14:20:36 on Aug. 22, 1984  
Raw: R52353 Enlarged X 1  
Plot: 5 to 20 min.

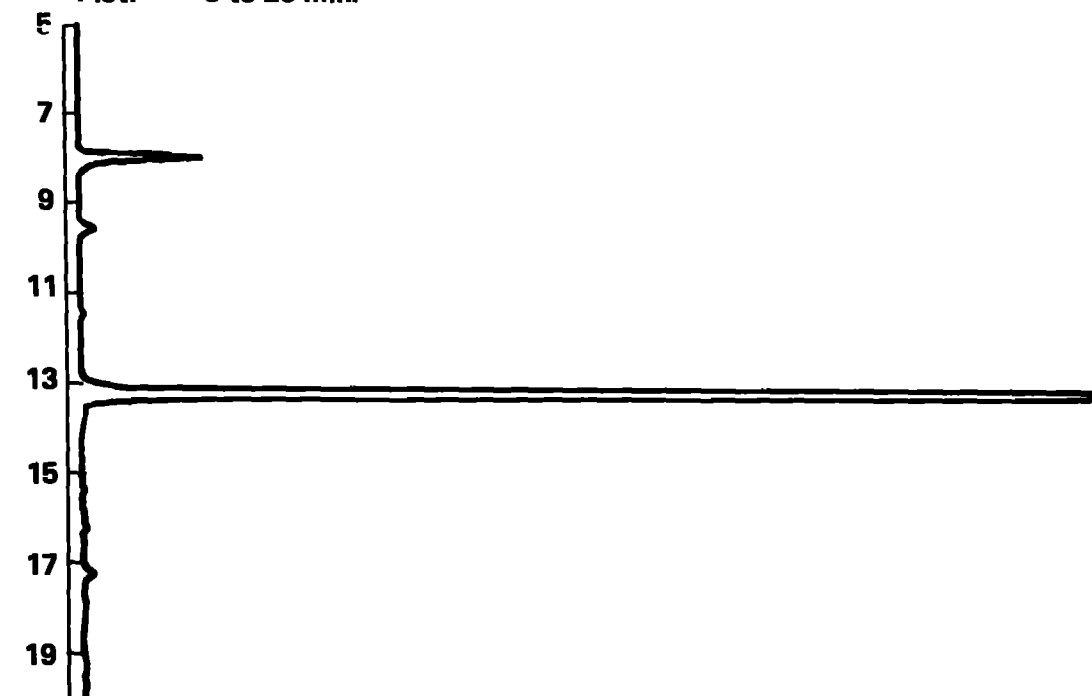
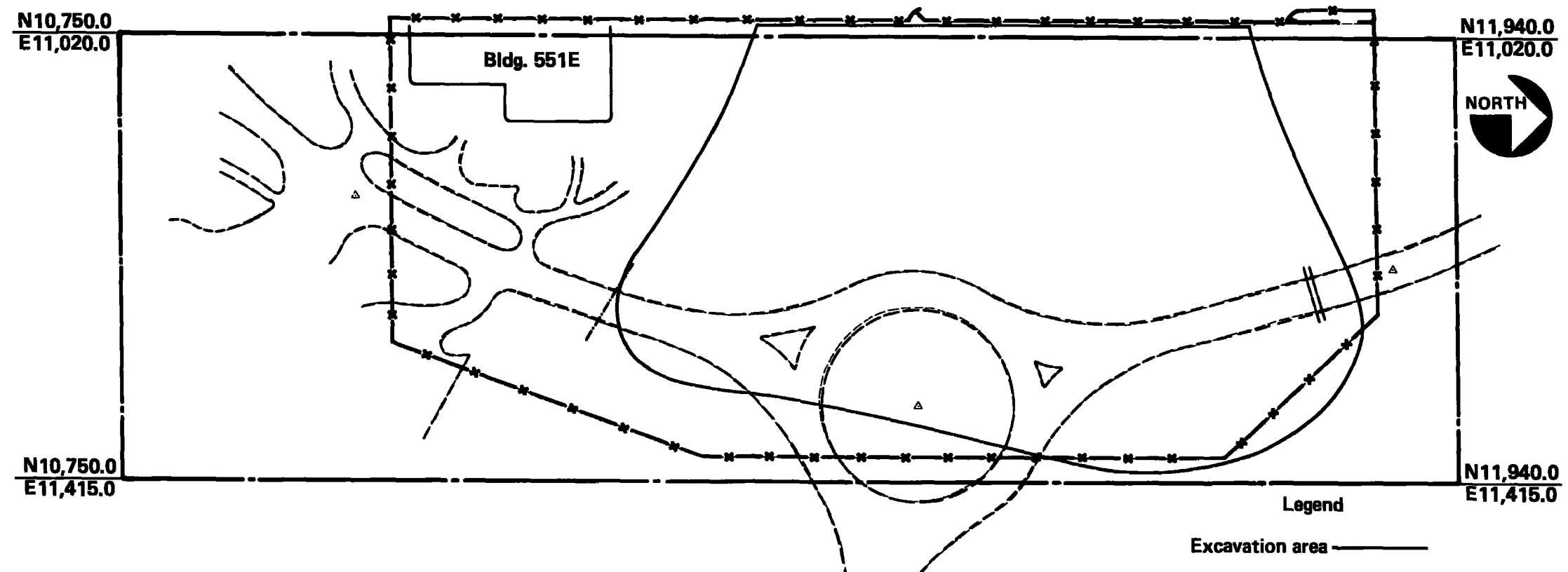


Figure 20. Chemical analysis of drum containing DER332 (from Fig. 18).



**Figure 21. Excavated area in the East Traffic Circle Landfill.**

#### 4.3 Soil Borings

The first soil sample of this investigation was collected by coring 6 inches below the bottom of the first hole, A-3, (see Fig. 11, Section 4.1), where landfill debris was first discovered. This was composited with other soil from that hole and analyzed for the priority pollutants, complete CAM (California Assessment Manual) metals, asbestos, and PCBs. Because of the non-homogeneous nature of the landfill debris, composite samples are assumed to give the most representative picture of the waste. Those results are listed in Table 1 (in Appendix A) and were presented in the East Traffic Circle Landfill Investigation Plan submitted on September 13, 1984, to the DOHS and RWQCB. No priority pollutants were detected.

Figure 12 (Section 4.1) shows the location of boreholes that were drilled early in 1984 and on September 19-21, 1984. The earlier soil cores were collected as part of the LLNL groundwater investigation. Since the entire soil column had been preserved, it was possible to extract samples from various depths in the columns for analysis (Ref. 15). Generally, samples were extracted at the 10- to 10.5-foot and 20- to 20.5-foot sections of the columns. This corresponds to the 5- to 5.5-foot and 10- to 10.5-foot depths below the current surface elevations. Both sets of soil cores were analyzed for CAM total metals, fluorides, and PCBs (see Tables 1, 2, and 3, in Appendix B. The CWET (California Waste Extraction Test) was also performed on six samples to establish a correlation between the TTLC and STLC concentrations (Table 5 in Appendix B and Figs. 22-25). The CWET was performed for CAM metals where the TTLC concentration exceeded the STLC thresholds. CEC and pH were also determined for selected samples (see Section 4.6).

The locations of core samples taken during the September 19-21 period were selected based on the results of previous samples from the short trenches before excavation and on the areas where PCB capacitors were found. Cores were concentrated in the areas of high contamination (primarily the north-eastern corner) and others were selected for good areal distribution. Sample depths were chosen at 2 to 2.5 feet, 5 to 5.5 feet, and 10 to 10.5 feet in most bore-hole locations. The upper two samples were analyzed and the lower sample was held pending the results of the first two (see Appendix B).

Six core samples were chosen to establish a relationship between total metal concentrations and soluble metal concentrations. This relationship is presented in Figs. 22-25. With these, we can compare the analytical results from the total concentration extractions to the lower state standards, the soluble threshold concentration. Since all of the concentrations were low, a sample from one of the contaminated metal's piles was added to the curves (sample number MP-818). This sample was analyzed for soluble metals earlier in the investigation, but not for total metals. Another sample from the same pile that was analyzed for total metals was chosen for the comparison. Soluble concentrations for zinc were too low to establish a reasonable curve.

Total PCB concentrations in almost all the cores were very low or below detection. Core GC-1B had the highest level with 310 mg/kg (see Figs. 12, 22, and 26). This was the area in which PCB capacitors were originally discovered. The deeper core within that same area showed no sign of PCB contamination. This area along with WA3-1B (Figs. 12 and 27) and NR5-1B (Fig. 12) have been excavated to a depth of 5 and 20 feet in diameter.

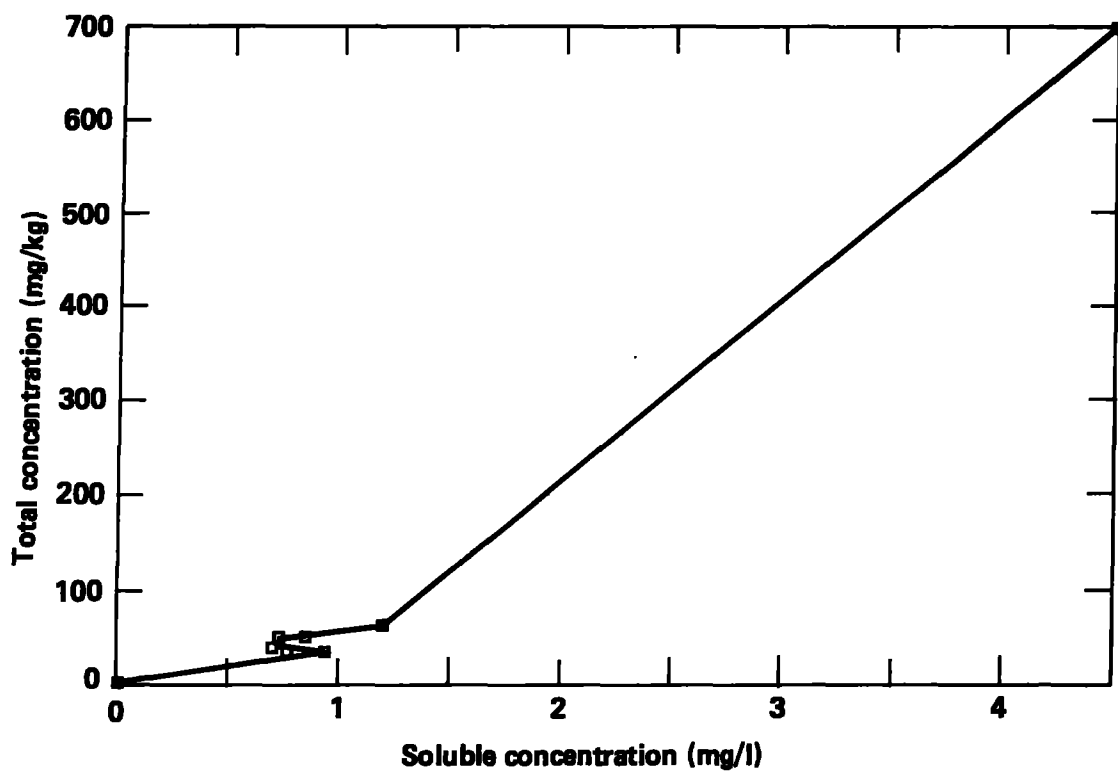


Figure 22. Total concentration vs soluble concentration for nickel.

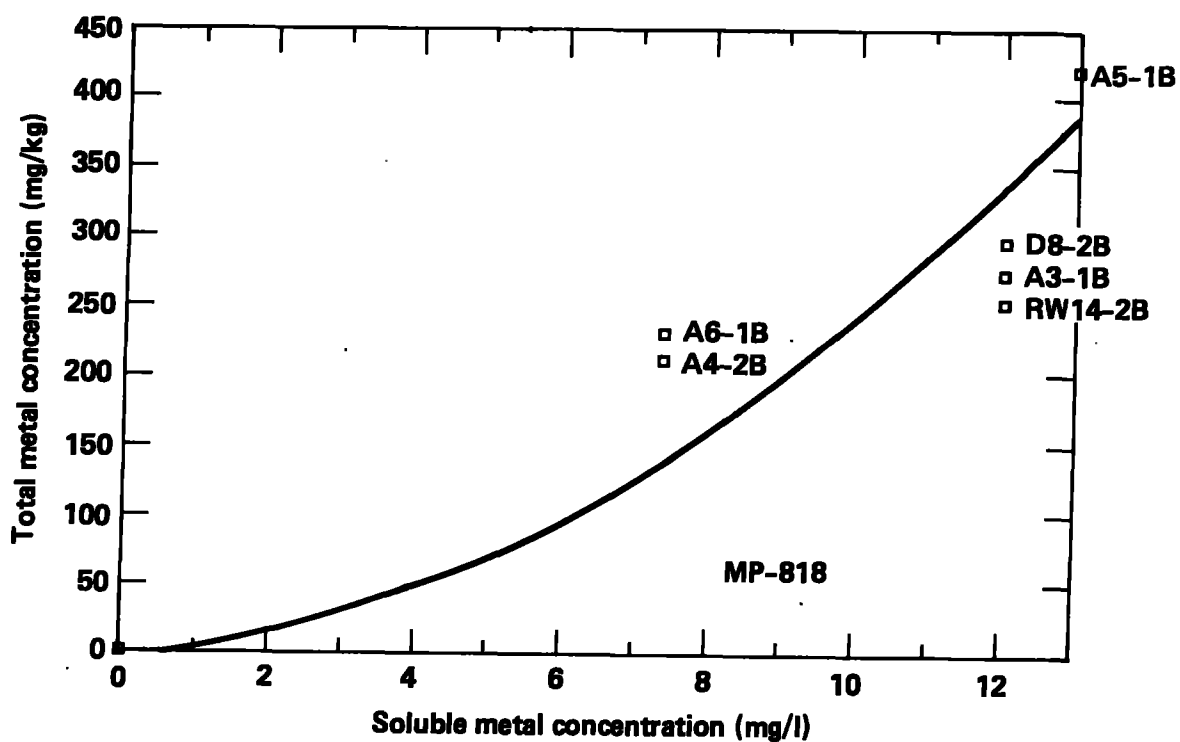


Figure 23. Total concentration vs soluble concentration for barium.

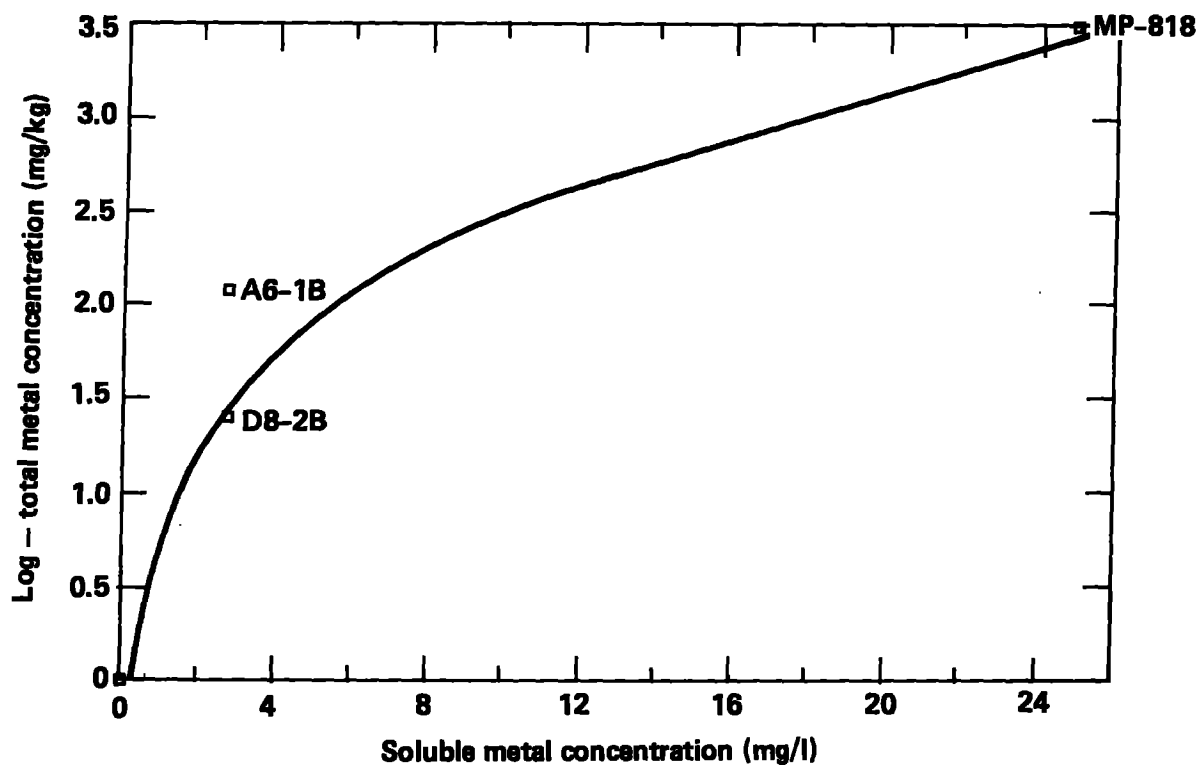


Figure 24. Total concentration vs soluble concentration for copper.

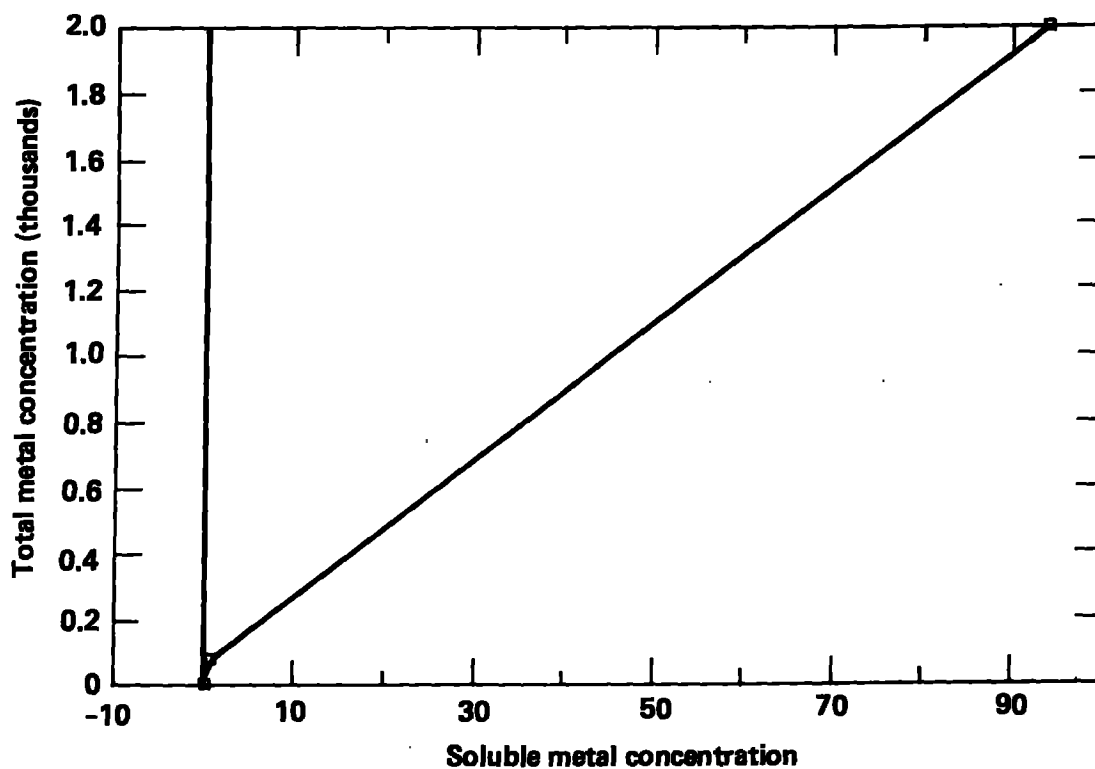
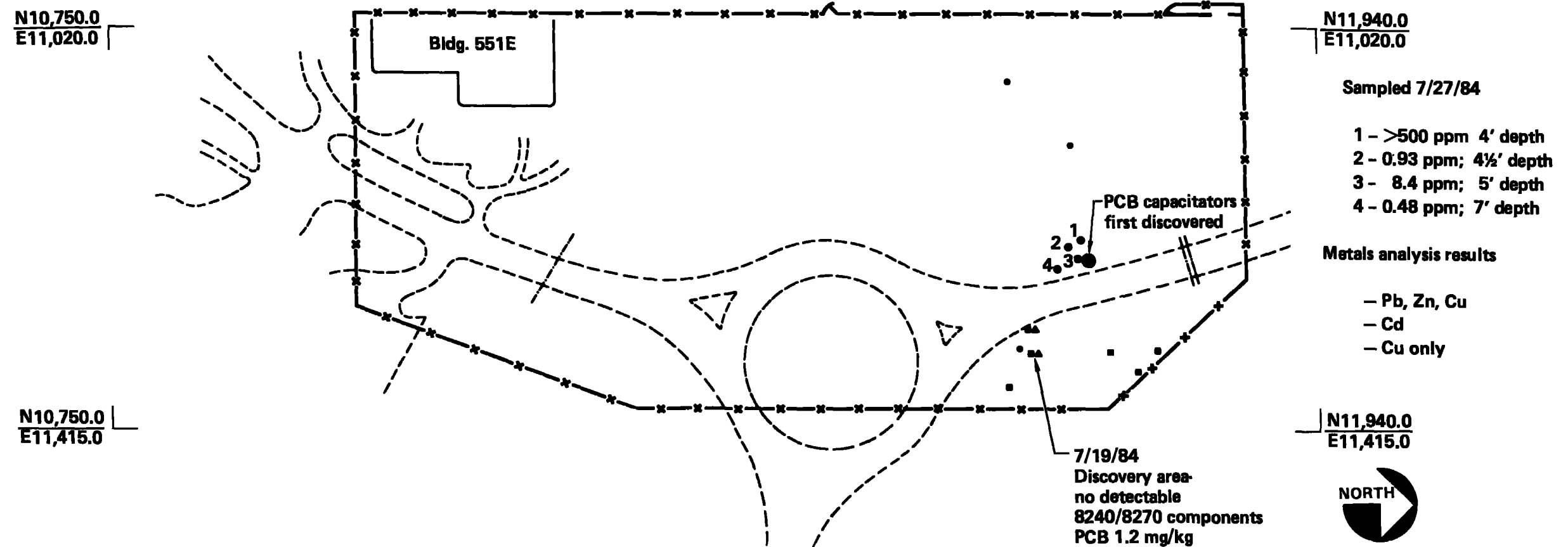


Figure 25. Total concentration vs soluble concentration for lead.



**Figure 26. Locations of PCB-capacitors and soil analyses.**



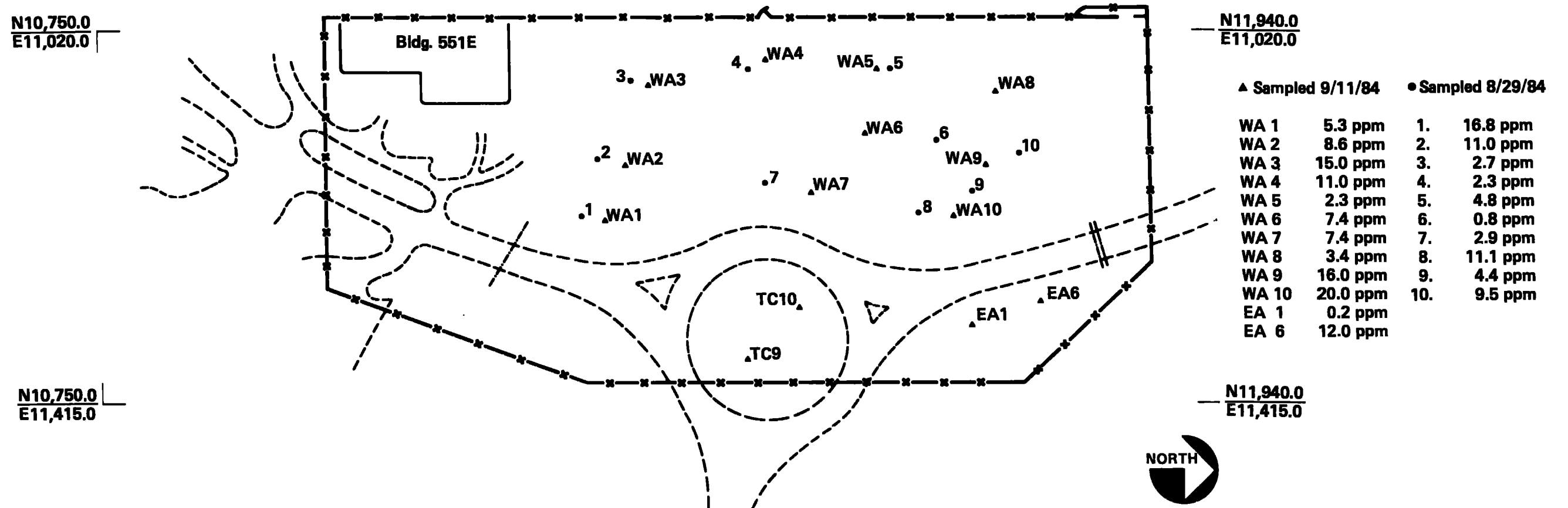


Figure 27. PCB sample locations and analyses.

#### 4.4 Post Cleanup Samplings

##### 4.4.1 Landfill Area

As part of the cleanup plans presented to the DOHS and RWQCB, LLNL proposed to verify sufficient cleanup of the landfill by taking a number of samples at various depths in a grid pattern within the landfill area (Fig. 12). These were used to identify more contamination and confirm a cleanup level. After presenting this plan to the DOSH and RWQCB on September 13, 1984, LLNL decided to proportion the final sampling to the areas of contamination, as suggested by the DOSH and RWQCB. Most of the core locations were selected to coincide with areas where the highest metal or PCB contamination was found. Also at the suggestion of the RWQCB, the final soil cores did not include priority pollutant analyses. Instead, the decision was made to install groundwater monitoring wells as part of the LLNL Livermore Groundwater Investigation. Replicate samples were collected and made available to the DOHS. Samples were analyzed by Brown and Caldwell for the following:

- California Assessment Manual total metals (AA analysis)
- PCBs
- Volatile and semi-volatile organics (EPA 8240 and 8270)
- Asbestos
- Radioactivity

Comparing total metals concentration to the STLC values, all metals were below the STLC values. Cores also indicated that the PCB-contaminated soil had been removed to a level of less than 0.05 mg/kg. The excavated area was backfilled as described in Section 4.7 (see Fig. 28).



**Figure 28.** After confirmation of the sample analysis, the area was backfilled and returned to grade.

#### 4.4.2 Waste Piles

Samples from the piles of excavated contaminated soil were analyzed for metals and PCBs to confirm the pile contents prior to disposal (see Fig. 29 for waste-pile locations). Samples were collected with a hand-driven auger 4 to 6 inches below the surface of the pile and packed in a screw-top 4-oz bottle, labeled, and sent out the same day for analysis. The hand auger was cleaned of any remaining soil and the wooden packing stick was discarded. Brown and Caldwell analyzed the samples for total and soluble CAM metals and total PCBs.

When PCB samples from piles indicated PCB contamination above 50 ppm, the area of the pile above 50 ppm was removed and isolated into a separate pile. Several scan samples of the PCB-contaminated area were taken and analyzed by the lab with a McGraw-Edison PCB field test kit. This kit gave a reliable estimate of the concentration of PCBs with a sensitivity of 40 ppm. The contaminated area was excavated and resampled for further contamination. This process was repeated until no PCBs were detected. Tables 1 and 2 (Appendix C) show the results of sampling after soil has been removed from the contaminated portion of the piles. Additional pile sampling locations and analyses are shown in Appendix F with the analytical results.

The first PCB-contaminated piles (greater than 50 ppm) were taken to the Kettleman Hills Facility (Coalinga, California) owned by Chemical Waste Management, Inc. The remaining PCB piles (#2, part of #3, and #15) were removed to Beatty, Nevada. The piles with heavy metal contamination were taken to the Benicia facility (Benicia, California) owned by IT Corporation. All waste was hauled by state-registered hazardous waste haulers. All manifests have been sent to DOHS as required by law.

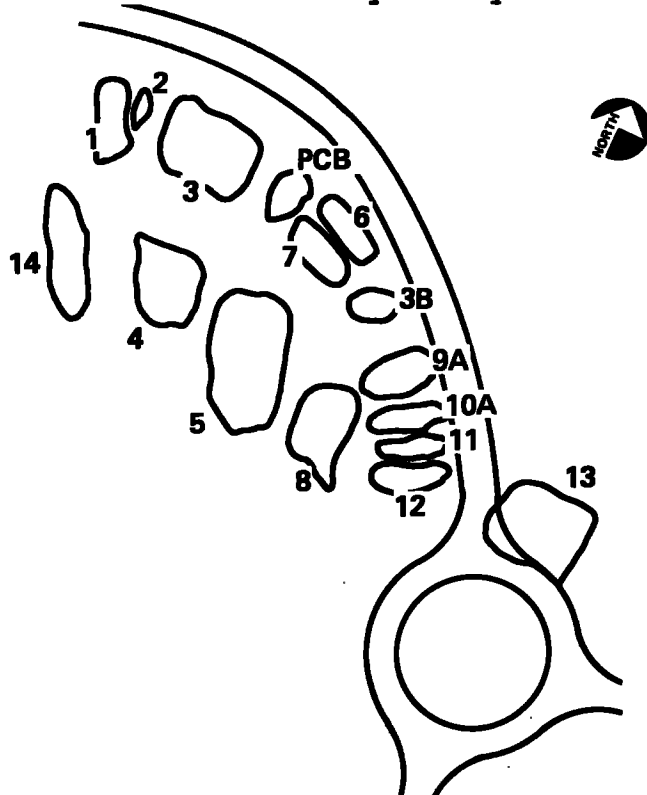


Figure 29. Location of contaminated soil piles, October 1984.

#### 4.4.3 Waste Storage Area After Removal of Piles

LLNL implemented a plan to sample and analyze soils from the area beneath and around the piles of wastes and contaminated soils after the piles had been hauled and disposed of by a state-certified hazardous waste contractor. The purpose of this state-approved plan was to assess the potential dispersal of contamination from the sixteen discrete piles of contaminated soil and wastes excavated from the East Traffic Circle Landfill. Samples were taken of the surface soil at fifty foot intervals around the piles and at least two samples were taken downwind of the pile storage area (see Fig. 30).

The results of the TTLC analyses for copper, lead, zinc, and PCBs are presented in Table 1 of Appendix D. None of the samples showed the metals or PCBs in excess of the state TTLC guidelines. In Section 4.6, a rationale is presented that the Livermore site soils have sufficient sorptive capacity to prevent the migration of any remaining metals. The maximum measured PCB TTLC (9.6 ppm) is only one fifth the TTLC standard value (50 ppm) for hazardous wastes. The DOHS approved the pile removal as adequate after reviewing the analytical results, the rationale discussed in Section 4.6, and LLNL's plans to eventually cover the area with office buildings, parking lots, and landscaped areas.

#### 4.5 Chronology of Sampling Events

In this section, the sampling performed in the course of the East Traffic Circle Landfill investigation, excavation, closure, and disposal of excavated materials are listed.

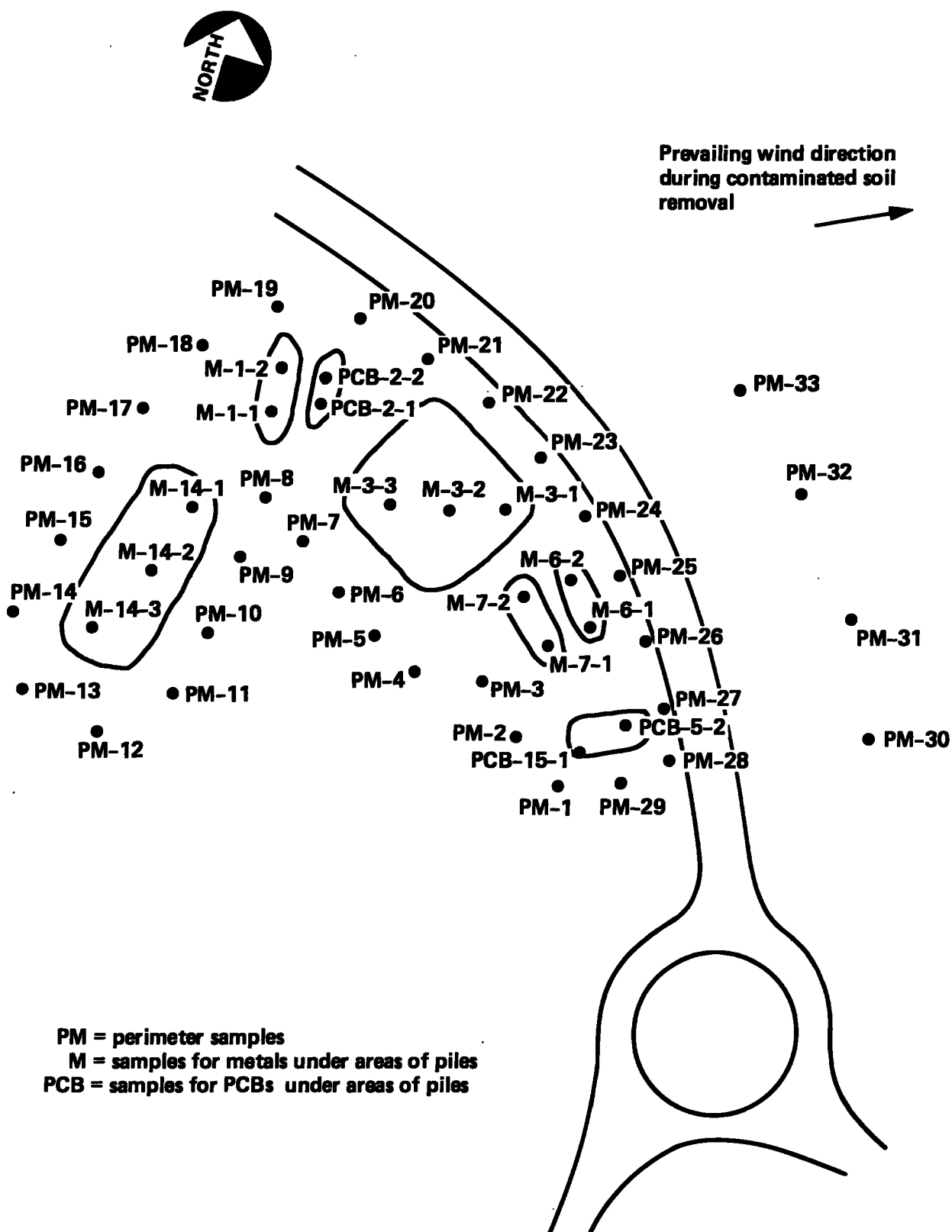
DATE(S) OF SAMPLING	LOCATION IN THIS REPORT	ANALYSIS	RESULTS
2/21-3/1/84 (reanalyzed on 9/24)	Fig. 3 & 12	CAM total metals, EPA 601/602, and PCBs	see Appendix B Tables 1 & 3
7/19/84	Fig. 26	TTLC metals EPA 8240/8270 PCBs	None detected  PCB: 1.2 ppb
7/24/84	A3, A6, C1, C4 trenches, Fig. 11	asbestos	none detected
7/26/84	D6 trench Fig. 11	PCBs	9.4 ppm Arochlor 1254
7/26/84	Fig. 13	X-ray fluorescence of metals	see Table 2 Appendix A
7/27/84	oil in capacitors, Fig. 26	PCBs	66 ppm of Arochlor 1254
7/27/84	old waste pit	EPA 601/602	Fig. 19

# **Chronology of Sampling Events (continued)**

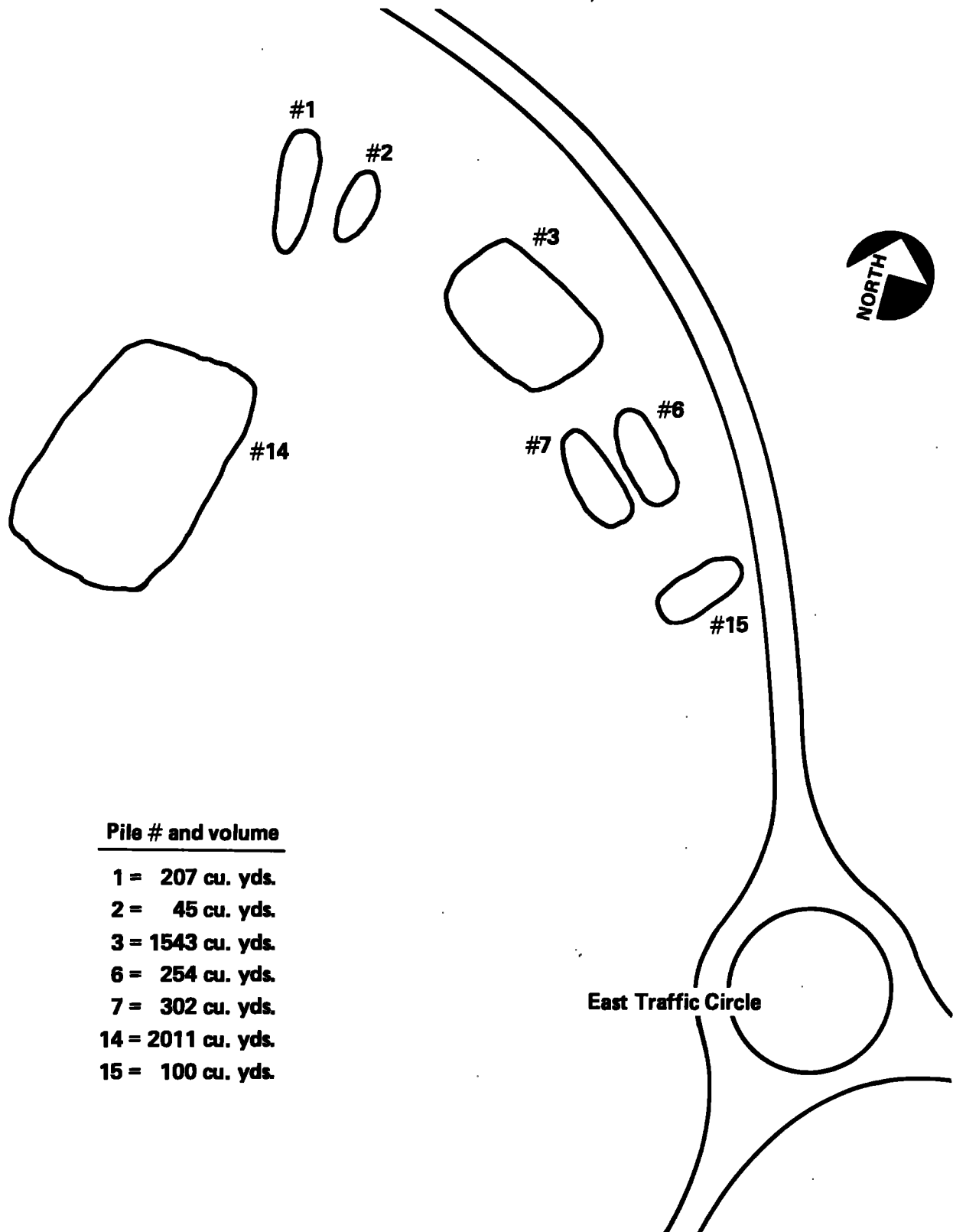
<b>DATE(S) OF SAMPLING</b>	<b>LOCATION IN THIS REPORT</b>	<b>ANALYSIS</b>	<b>RESULTS</b>
7/31/84	Fig. 12	TTLIC metals	see Appendix B: Tables 1, 2, and 3
8/1/84	drum site N of B-551; Fig. 19	TTLIC metals EPA 8240/8270	none detected
8/6/84	PCB discovery area Fig. 19	PCBs trichlorobenzene	PCBs 1.4-340 ppb trichlorobenzene less than 0.0001
8/8/84	13 randomly selected locations in the western half of the excavated area, Fig. 21	PCBs	less than 800 ppb
8/13/84	drum site north of B-551; Fig. 19	EPA 624/625	see Appendix A Tables 4, 5, 6
8/17/84	8 randomly selected loc. in the north- western portion of the excavated area, Fig. 21	PCBs	less than 50 ppb
8/20/84	Figs. F-1 through F-7		see Appendix F
8/22/84	utility trench/Fig. 2	X-ray fluorescence	trace Ni only
8/29/84	see Fig. 27	PCBs	Appendix C Table 2
8/30/84	resin drum north of B-551; see Fig. 19	HPLC for "fingerprint" I.D. with known resins	I.D. as DER 322 resin (See 4.2)
8/31/84	see Fig. 13 RW 1 - 6 only	X-ray fluorescence	Appendix A Table 2
9/11/84	see Fig. 27 WA1 - WA10; TC9, 10; EA1,6	PCBs	Appendix C Table 2
9/19/84	see Fig. 12	Cation Exchange Capacity (CEC)	see Sec. 5.2
9/19-9/21/84	see Fig. 12	CAM total & soluble metals, PCBs	see Figures 22-25

Chronology of Sampling Events (continued)

DATE(S) OF SAMPLING	LOCATION IN THIS REPORT	ANALYSIS	RESULTS
10/5/84	see Fig. 12 samples B5, D6	CAM total lead	9 ppm
10/5/84	core areas WA, NR5, GC, Fig. 12	Total PCBs	less than 800 ppb
10/8/84	Remaining piles Fig. 29	CAM total metals	Figs. F-1 thru F-7
6 & 7/85	State-certified hauler sampled materials prior to removal and transportation of hazardous wastes.		
8/85	State-certified hauler removed wastes from LLNL.		
9/9/85	Last of contaminated soil removed from LLNL. A sampling grid was staked and marked showing locations of pile boundries (Fig. 30).		
9/10/85	Completed sampling (49 samples total from Fig. 30). Samples to be tested for metals, nine of which are to be tested for PCBs.		
9/16/85	Sent soil samples to a state certified lab for analysis.		
10/8/85	Received soil analytical results from a state certified lab (see Appendix C, Table 3).		



**Figure 30. Locations of samples collected from the waste-pile storage area after the removal of the piles**



**Figure 31. Contaminated dirt piles - 6/26/85.**

#### 4.6 Mobility of Metals - pH, Cation Exchange Capacity, and PCBs

The relative mobility of metals in the geosphere (discussed in Section 3.4.5) is strongly influenced by the partitioning of metals between the solution and the particulate phases. Soil pH and cation exchange coefficients were measured on selected soil samples to calculate the sorptive capacity of LLNL soil.

Ten core samples were selected to determine the pH of the soil underlying the landfill. Selection was based on areal distribution and depth. In addition, two samples were selected to obtain the CEC. The results are shown below.

<u>Core Number</u>	<u>pH</u>	<u>CEC (meg/100 g)</u>
A3-1B	7.9	10
A3-2B	8.2	--
A6-1B	7.9	--
A6-2B	7.6	--
D8-1B	5.8	--
D8-2B	7.4	--
RW14-1B	7.9	--
RW14-2B	7.8	16
WA10-1B	6.5	--
WA10-2B	7.1	--

The average pH is about 7.3 with slightly higher pH in the deeper samples. The relationship of pH to metal solubility (see Fig. 32) is established in Ref. 12 (on the attenuation of heavy metals in power plant ash pond leachate).

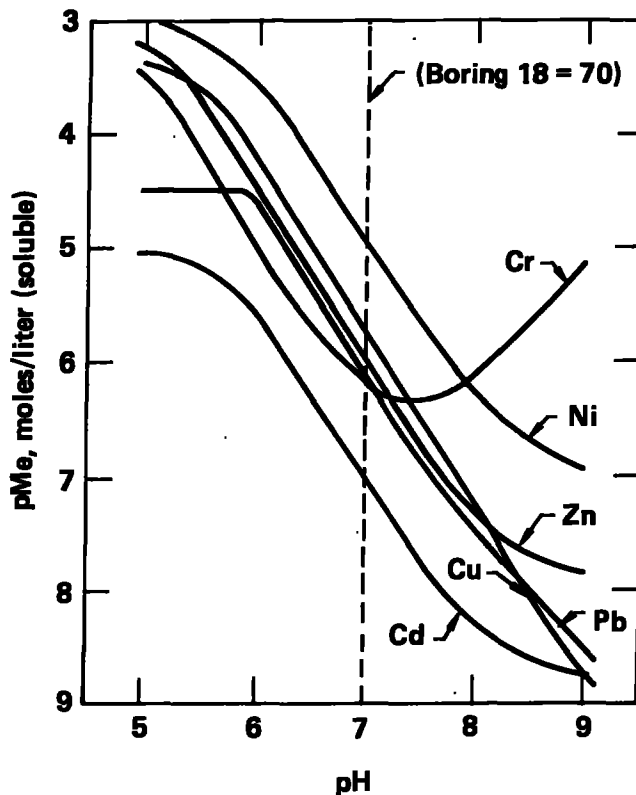


Figure 32. Sensitivity of predicted total soluble metals as pH varies.

From the above pCATION vs pH relationship, these solubilities can be derived:

<u>CATION</u>	<u>pCATION</u>	<u>SOLUBILITY (mg/l)</u>
lead	6.6	0.052
zinc	6.5	0.021
copper	6.2	0.040
cadmium	7.5	0.004
chromium	6.2	0.033
nickel	5.4	0.240

Since the pH of the area is in the 7-8 range, the particulate species of metals tend to dominate according to the pH vs pCATION relationship (Ref. 12). The predicted solubilities for copper, lead, and zinc are less than 60 ppb. From Appendix A, Table 1, the CEC is approximately 130 meg/kg. Given a worst-case senario of lead, zinc, copper, and cadmium concentrations at the total metals threshold for hazardous waste, the following would be required:

<u>CATION</u>	<u>THEORETICAL CONCENTRATION (mg/kg)</u>	<u>meg/kg</u>
lead	1000	4.8
zinc	5000	75.8
copper	2500	39.1
cadmium	100	0.9
	total	120.6 meg/kg

A CEC of 120.6 meg/kg would be needed to sorb cations at these concentrations. Thus, the CEC potential of the area is adequate to sorb or bind metal pollutants even in this worst-case scenario. According to Ref. 16, PCBs are not readily leached from soils by water. Thus, any PCBs left in place should be relatively immobile.

#### 4.7 Soil Sieve and Proctor Density Analysis, and Backfilling

Sieve analyses of two samples obtained from on-site excavations are presented in Table 4-A. These indicate that materials available within LLNL are high in fines. Based on field experience at LLNL, the fine fraction in near-future soils is generally plastic and, therefore, these materials can be expected to vary from clayey sand (SC\*) to very sandy clay (CL-SC\*). The Proctor density ranged from 110 - 115 pcf\*\* and the plastic index ranged from 10 - 20. When compacted to 95% of maximum density, these materials are typically of low permeability (e.g.,  $10^{-4}$  to  $10^{-6}$  cm/sec). Test results for the import soil are shown in Table 6-B. The test data indicates that this soil is a sandy clay (CL-SC\*) with dominantly fine sand. This material can be expected to have a low permeability (e.g.  $10^{-6}$  cm/sec) when compacted to 95% of maximum density.

The area was backfilled to slightly higher than its original grade and compacted to 95% of maximum density, resulting in a landfill cover of approximately 5-7 feet. Backfill material was obtained from two sources: one on-site and one of selected import materials.

\* Unified Soil Classification System

\*\* ASTM D1557-78, modified to 3 layers, 5 tests

Test results for the import soil are shown in Table 1 of Appendix E. The test data indicate that this soil is a sandy clay (CL-SC\*) with predominantly fine sand. When compacted to 95% of maximum density, this material can be expected to have a low permeability (e.g.,  $10^{-6}$  cm/sec).

#### 4.8 Geophysical Investigations

Geoconsultants, Inc. outlined a broad anomalous area on August 27, 1984. Several smaller anomalies within that area were marked in the field. Much of the southern portion of the surveyed area displayed positive and negative anomalies having a total magnetic intensity of 1100 gammas or less. All of the anomalies appeared to be of natural origin or associated with major cultural features such as buildings or earth-moving equipment. In the northern portion of the landfill area, the anomalies appear to be smaller, more isolated, and of higher total magnetic intensity. This was caused by the scattering of dumped metal debris, the power line extending along the north boundary of the site, and partly by the greater density of stations in the area.

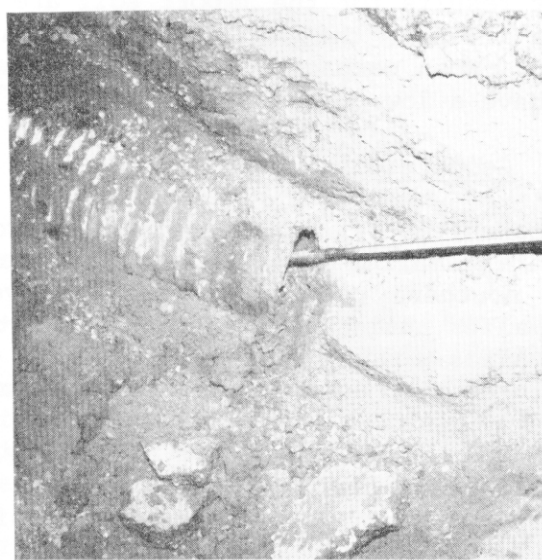
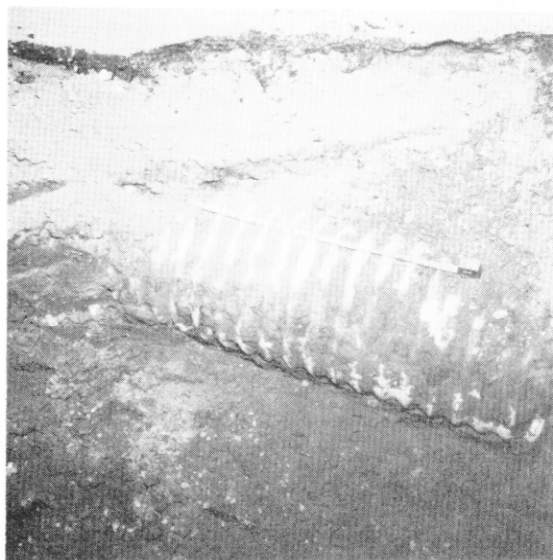
The anomalies that are of most interest for the purposes of this survey are outlined on the contour map of Fig. 36 and generally have a total magnetic intensity of 1100 to 1200 gammas or higher. At least one of the anomalies north of the East Traffic Circle yielded buried capacitors.

The magnetometer survey performed by Geoconsultants, Inc. indicated that the area south of Building 551 does not contain debris. Three exceptions to this are three small anomalies located under the parking lot southeast of Building 551 (see Fig. 36). These anomalies were resurveyed using the magnetometer by Geoconsultants. This survey was completed on October 8, 1985, with the same results as indicated on August 27, 1984.

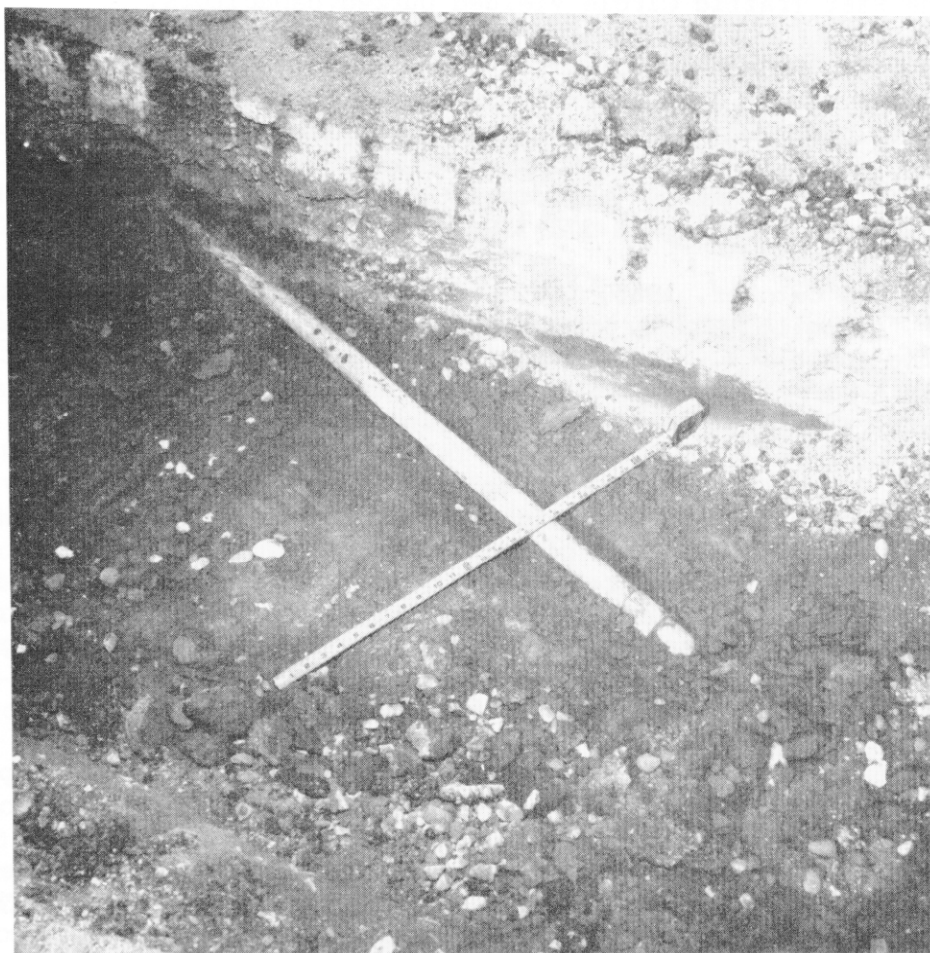
In September and October, 1985, LLNL reviewed its surveyor's logbooks, utility plans, and "as-built" construction diagrams in attempts to reveal probable causes of the anomalies. The anomaly farthest to the southeast matched fairly well with a steel culvert that had been buried in place. The other two anomalies were still, at that time, unexplained.

On October 2, 1985, LLNL performed an electromagnetic or conductivity survey of the area in an attempt to gain more information on the cause(s) of the magnetometer anomalies. The conductivity meter responded well to steel reinforcing bars in the concrete curbs with values about ten times that of background (25 to 40 mS/m) and to the anomaly farthest to the southwest. The spacing between the measurement stations may have been too large and the orientation of the transmitting and receiving coils may have been misaligned such that it did not respond to the other two anomalous locations.

On November 6, 1985, LLNL used the Heliflux Magnetic Locator to pinpoint these anomalies. The anomalous areas were marked with paint and their sources were revealed after careful digging through the asphalt on November 19, 1985. The anomalies farthest to the northeast and to the southeast were caused by steel culverts 1 foot in outside diameter (see Figs. 33 and 34). The anomaly farthest to the southwest (Fig. 35) was caused by a steel conduit for electrical wiring. There was no other debris associated with these steel objects. After surveillance with radiation detection instruments, the holes were backfilled and recovered with asphalt.



**Figures 33 and 34. Corrugated drain pipe found in two of the anomalous areas.**



**Figure 35. Unused electrical conduit found in the third anomalous area.**

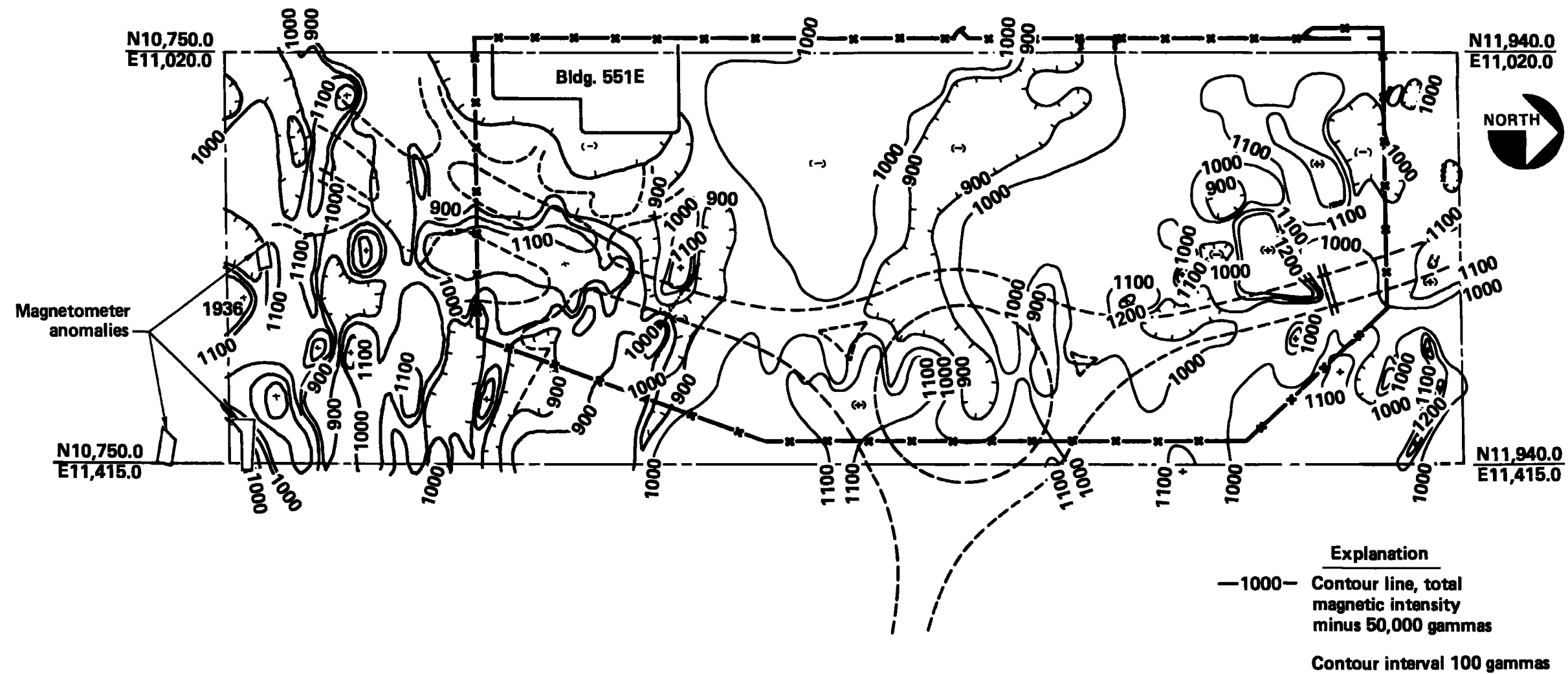


Figure 36. Contour map of magnetometer survey area.

#### **4.9 Waste Storage and Disposal**

##### **4.9.1 Quantity Stored and Location**

Material excavated from the landfill area totaled 13,971 cubic yards (see Fig. 31). By January of 1985, 8,204 cubic yards were removed from LLNL. The remaining 5,767 cubic yards remained on site until September of 1985.

##### **4.9.2 Storage Procedures**

Efforts were made to segregate PCB-contaminated soils and PCB capacitors from other contaminated wastes. The excavated soil was placed on a 30-mil synthetic base, segregated and labeled as to waste type, and later covered to prevent run-on, run-off, and wind dispersal (see Fig. 9, Section 3.6). PCB capacitors were packed in drums and moved to Building 625 (LLNL's PCB storage facility) for storage while awaiting disposal.

##### **4.9.3 Disposal Procedures**

All waste material containing metals exceeding the state action level was shipped to a state-approved Class I disposal site. Contaminated soil with less than 50 ppm of PCB was sent to a state-approved PCB landfill. PCB-contaminated soil exceeding 50 ppm was shipped by IT Corporation to Beatty, Nevada.

## 5. Closure of the East Traffic Circle Landfill

### 5.1 Condition of Landfill

Almost all of the remaining soil at the landfill contains metals at background levels. Even when comparing total metal concentrations to the STLC values, all metals were below the STLC values. For almost all parts of the landfill, PCBs were undetectable. Sample B5-3A was analyzed to confirm that LLNL had excavated to the vertical extent of the contaminated sample. D6-2A was also low in lead indicating that the vertical extent of this contamination was no more than 5 feet. In both cases, as with the rest of the landfill, those areas of high contamination were characterized by darker soil. All of this soil was removed both vertically and areally.

### 5.2 Mitigation Measures

The excavated area was backfilled to slightly higher than its original grade and compacted to 95% of maximum density. This resulted in a cover on the landfill of approximately 5 to 7 feet. Backfill material was obtained from two sources: one on site and one of selected import materials. The discussion in Section 4.7 concludes that the permeabilities of these materials would be low (e.g.,  $10^{-4}$  to  $10^{-6}$  cm/sec for the LLNL soil and  $10^{-6}$  cm/sec for the imported soil).

Figures 14-17 (from Section 4.2) indicate the percentage of total metals that are soluble. Less than 5% of the four metals on these graphs are present in the soluble form. Since these metals represent both mono and divalent forms, it can be expected that they represent the pattern of solubility for all of the CAM metals except for chromium III and VI. For these two species, the total concentrations were already below the STLC value. We conclude, therefore, that the soluble metal concentrations remaining in the landfill are well below the CAM STLC.

Based on the investigation of potential mobility, LLNL does not expect leaching of any residual metals or PCBs to groundwater. The pH of the area is generally in the 7-8 range; therefore, the particulate species of metals would tend to dominate. The predicted solubilities for the principal metals, lead, copper, zinc, and cadmium, as shown in the relationship of pH vs pCATION (Ref. 7), are less than 60 ppb.

Soil properties of the area would tend to reduce leaching of organic constituents. The texture, structure, amount of clay present, CEC, and pH all will contribute to reduce leachability.

The Cation Exchange Capacity (CEC) is particularly good index for estimating the degree of adsorption to be expected for cationic species. The CEC potential of the area has been shown to be adequate to bind the metal pollutants.

Little chance for mobility remains. The CEC, pH, and relationship between total and soluble metals indicate that should any residual contaminants remain, it will be tightly held in the upper few feet of soil.

Existing hydrologic data for the East Traffic Circle Landfill area suggests variability in the infiltration potential for the area. High infiltration rates may be experienced in the area west of the landfill where excavation of an enclosed depression led to the removal of near surface soils causing the ponding and infiltration of water. Low infiltration rates may prevail elsewhere since the near surface soils have remained largely in place beneath the former landfill. A cover thickness of 5-7 feet, along with good compaction, will also help mitigate any possible migration.

## 6. Continuing Investigations

Groundwater monitoring in the area of this decommissioned landfill site is addressed as part of the Livermore Site Groundwater Investigation that is currently underway (Ref. 8). Previous work, as mentioned in the Executive Summary, showed soils with nearly 1 ppm of TCE and PCE at depths of 21 to 51 feet, and lesser amounts (10-20 ppb) in the 0-12 foot depth range. One soil sample collected beneath approximately 20 empty drums, showed 11 ppm of TCE and 50 ppm of PCE (Ref.15). The source and effect of volatile chlorinated organic contamination on groundwater quality is uncertain at the present time in this area. A new well, MW-142, installed in the Traffic Circle shows 410 ppb TCE and a variety of other chlorinated organics. The groundwater occurrence and quality in the area will be investigated further (Ref. 8).

### Acknowledgments

In addition to the authors listed, the following people contributed to the investigation, the cleanup, or the preparation of this report:

J. L. Cate	J. R. McNabb
G. Duarte	B. C. Musgrave
L. A. Fry	D. S. Meyers
M. A. Gonzalez	C. B. Ozaki
J. C. Hand	G. A. Rochin
D. A. Hieb	D. R. Sapone
C. Huntzinger	J. C. Steenhoven
J. A. Loftis	J. J. Sweeney

The LLNL laborers, staff members of the Environmental Protection Program, the Hazards Control Analytical Laboratory, the Hazardous Waste Management Program, and other LLNL employees also made contributions.

### References

1. M. Dreicer, Preliminary Report on the Past and Present Uses, Storage, and Disposal of Hazardous Materials and Wastes on the Lawrence Livermore National Laboratory, UCID-20442 Draft, May 1985.
2. J. T. Davis, Director, Environment Safety and Quality Assurance Division, Department of Energy, San Francisco Operations Office, letter to K. Ernst, manager, Plant Services, LLNL, (July 31, 1985).
3. D. R. Hoenig, Chief, North Coast California Section, Toxic Substances Control Division, Department of Health Services, letter to J. T. Davis (August 14, 1984).
4. U.S. Department of Energy, Final Environmental Impact Statement, Lawrence Livermore National Laboratory and Sandia National Laboratories - Livermore Sites, Livermore, California, DOE/EIS-00228 (July 1982).
5. T. W. Dibblee, Jr., A Preliminary Map of the Altamont Quadrangle, Alameda County, California, U.S. Geological Survey, Denver, CO, Open-File Report 80-538 (1980).

7. CDWR , Livermore and Sunol Valleys, Evaluation of Ground Water Resources Appendix A: Geology, Bulletin 118-2, State of California, Department of Water Resources, Sacramento, CA. (1966)
8. Weiss Associates, Annual Report for Fiscal Year 1985: Groundwater Investigation at Lawrence Livermore National Laboratory, Volume One, (December 1985).
9. Frederic Hoffman, Project Leader, LLNL Livermore Groundwater Investigation, private communication (January 1986).
10. R. Stone, M. R. Ruggieri, L. L. Rogers, D. O. Emerson and R. W. Buddemeir, Potential for Saturated Ground-Water System Contamination at the Lawrence Livermore National Laboratory, Univ. of Calif., Lawrence Livermore, National Laboratory, UCRL-53426 (1982).
11. D. C. Helm, Ground-Water Contour Map of LLNL Site, (Winter 1983-84, Memorandum to D. W. Carpenter, University of California, Lawrence Livermore National Laboratory from D. C. Helm, University of California, Lawrence Livermore National Laboratory (1984).
12. Theis, T. L., R. O. Richter, Chemical Speciation of Heavy Metals in Power Plant Ash Pond Leachate, Environ. Sci. Technol., Vol. 13, No. 2, February 1979.
13. USEPA, Hazardous Waste Land Treatment, Office of Solid Waste and Emergency Response, SW-874, April 1983.
14. Richard C. Benson, Robert A. Glaccum, and Michael R. Noel, "Geophysical Techniques for Sensing Buried Wastes and Waste Migration: An Application Review," Proceedings of NWWA/EPA Conference on Surface and Borehole Geophysical Methods in Groundwater Investigations, San Antonio, Texas, pp. 533-566, February 7-9, 1984.
15. J. P. Como and M. A. Gonzalez, East Traffic Circle Landfill Investigation Plan, informal report presented to DOE, RWQCE, and DOSH (September 13, 1984).
16. Polychlorinated Biphenyls (PCBs), California State Water Quality Control Program Special Projects Report No. 83-lsp (May 1983).

**APPENDIX A****TABLE 1 - RESULTS FROM CORE SAMPLES TAKEN BELOW HOLE A-3**

<u>Substance</u>	<u>Concentration ppm</u>	<u>State Hazardous Waste Designation (total ppm)</u>
Antimony	31	500
Arsenic	45	500
Barium	400	10000
Beryllium	45	75
Cadmium	72	100
Chromium (+6)	less than 0.6	500
Chromium (total)	150	2500
Cobalt	37	8000
Copper	16000	2500
Lead	5600	1000
Mercury	16	20
Molybdenum	37	3500
Nickel	390	2000
Selenium	10	100
Silver	110	500
Thallium	14	700
Vanadium	13	2400
zinc	9900	5000

# APPENDIX A

**TABLE 2 - METALS ANALYZED BY X-RAY FLUORESCENCE**

<u>Sample Number</u>	<u>Trace</u>	<u>Medium</u>	<u>Heavy</u>	<u>Sampling Date</u>
A1	Cu,Zn,Pb	-	-	7/26/84
A2	Cu,Zn	-	-	7/26/84
A3	-	-	Cu,Zn,Pb	7/26/84
A4	-	-	Cu,Zn,Pb	7/26/84
A5	-	Cu,Zn,Pb	-	7/26/84
A6	-	-	-	7/26/84
A7	-	Cu	Cu,Pb	7/26/84
B1	-	Cu,Zn,Pb	-	7/26/84
B2	-	Cu,Zn,Pb	-	7/26/84
B3	-	-	Cu,Zn,Pb	7/26/84
B5	-	-	Cu,Zn,Pb	7/26/84
C1	Cu	Zn	-	7/26/84
C2	Cu,Zn	-	-	7/26/84
C3	Cu,Pb	Zn	-	7/26/84
C4	-	-	-	7/26/84
C12	-	-	-	7/26/84
D1	-	Cu,Zn	-	7/26/84
D2	-	-	-	7/26/84
D3	-	Cu,Zn,Pb	-	7/26/84
D4	Zn	-	-	7/26/84
D5	Zn	-	-	7/26/84
D6	-	-	Cu,Zn,Pb	7/26/84
D8	Cu,Zn,Pb	-	-	7/26/84
D11	-	Pb	Cu,Zn	7/26/84
D12	Cu,Zn,Pb	-	-	7/26/84
RW1	Cu,Zn,Pb	-	-	8/31/84
RW2	Cu,Zn,Pb	-	-	8/31/84
RW3	Cu,Zn	Pb	-	8/31/84
RW4	Cu,Zn,Pb	-	-	8/31/84
RW5	-	Cu,Zn,Pb	-	8/31/84
RW6	Cu,Pb	Zn	-	8/31/84
RW13	Cu,Zn,Pb	-	-	9/10/84
RW14	Cu	Zn,Pb	-	9/10/84
RW15	Zn,Pb	-	-	9/10/84
RW16	Zn,Pb	-	-	9/10/84
RW17	Zn,B,Pb	-	-	9/10/84
RW18	Zn	-	-	9/10/84

# APPENDIX A

**TABLE 3 - RESULTS OF PHA RADIOACTIVITY ANALYSES**  
(See Fig. 12 for sampling locations)

<u>Date</u>	<u>Hole Number</u>	<u>Nuclide</u>	<u>Concentration</u>	<u>Amount Disposed Of</u>
8/7/84	NR-4	Ra <sup>226</sup>	72 pCi/gm	} 2.5 large barrels
		Th <sup>232</sup>	35 pCi/gm	
		U <sup>238</sup>	17 pCi/gm	
	B-5	D <sup>38</sup>	2680 pCi/gm	0.5 large barrel
	CF-4 & 6	U <sup>238</sup>	9.5 pCi/gm	} 0.5 large barrel
		Th <sup>232</sup>	24.6 pCi/gm	
	A-6	natural uranium	N/A	pipe
	A-3	Cs <sup>137</sup>	19.7 pCi/gm	2.5 large barrels
8/8/84	CF-3	Background soil	0	0
8/17/84	D-6	Co <sup>60</sup> rod	approx 2 mCi/rod	to H & S tech
8/20/84	RW17 & NR-5	Cs <sup>137</sup>	5520 pCi/gm	
		Ra <sup>226</sup>	119.2 pCi/gm	
	CF-6	Cs <sup>137</sup>	20.9 pCi/gm	1.0 large barrel
	CF-7	Cs <sup>137</sup>	6.45 pCi/gm	
9/11/84	NR-4	Cs <sup>137</sup>	161 pCi/gm	} 2.0 large barrels
		Am <sup>241</sup>	11.8 pCi/gm	
	NR-3	Cs <sup>137</sup>	25 pCi/gm	} 2.0 large barrels
		Cs <sup>137</sup>	36 pCi/gm	
9/13/84	NR-4	Cs <sup>137</sup>	440 pCi/gm	1.0 large barrel
9/17/84	R-N-1BK	Cs <sup>137</sup>	90 pCi/gm	1.0 small barrel
	NR-2	Cs <sup>137</sup>	41.5 pCi/gm	} 9 small barrels & 1 box
	NR-3	Cs <sup>137</sup>	54.5 pCi/gm	
		Am <sup>241</sup>	2.6 pCi/gm	
	NR-5	Cs <sup>137</sup>	1.2 pCi/gm	2.0 small barrels
	NR-6	Cs <sup>137</sup>	3256 pCi/gm	2.0 small barrels

One small barrel = 30 gallons = 300 pounds of soil  
 One large barrel = 55 gallons = 500 pounds of soil  
 One box = one wooden box (2 ft x 4 ft x 7 ft)

# APPENDIX A

**TABLE 4 - RESULTS OF CHROMATOGRAPHY/MASS SPECTROMETRY - EPA METHOD 624<sup>a</sup>**  
(Analysis performed on muddy water from a crushed drum in Area 5)

Date Sampled: 8/13/84

<u>Compound</u>	<u>Results: ug/L</u>
Purgeable Priority Pollutants:	
Dichloromethane (methylene chloride)	24
Trichloroethylene (TCE)	11
Benzene	1
Tetrachloroethylene (PCE)	3
Toluene	3
1,1-Dichloroethane	1
1,2-Dichloroethylene	20

Other purgeable pollutants would have been reported had they appeared at or above the following detection limits: (concentration: ug/L)

Purgeable Priority Pollutants (except those listed below:	1
Acrolien	10
Acrylitrile	10

<sup>a</sup> Analysis performed by Brown and Caldwell Analytical Laboratories.

## APPENDIX A

**TABLE 5 - RESULTS OF GAS CHROMATOGRAPHY/MASS SPECTROMETRY - EPA METHOD 625<sup>a</sup>**  
(Analysis performed on muddy water from a crushed drum in Area 5)

Date Sampled: 8/13/84

<u>Compound</u>	<u>Results: ug/L</u>
Extractable Priority Pollutants:	None detected
Semiquantified Compounds: <sup>b</sup>	
Unidentified	1000
Methylhexadecanoate	4000
C <sub>18</sub> -C <sub>20</sub> Saturated hydrocarbon	4000
C <sub>19</sub> H <sub>38</sub> O <sub>2</sub>	3000
Unidentified	2000

Extractable Priority Pollutants would have been reported had they appeared at or above the following detection limits: (Concentration: ug/L)

All base/neutrals (except those listed below:	150
All acids (except those listed below:	150
Benzidine:	15,000
3,3'-Dichlorobenzidine:	15,000
2,4-Dinitrophenol:	15,000
4-Nitrophenol:	15,000
4,6-Dinitro-o-cresol:	15,000

<sup>a</sup> Analysis performed by Brown and Caldwell Analytical Laboratories.

<sup>b</sup> These additional compounds were qualitatively identified by the data system. Quantification is based on comparison of total ion count of the compound with that of the nearest internal standard.

**APPENDIX A**

**TABLE 6 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY RESULTS - EPA METHOD 8240**  
(Analysis performed on soil collected beneath the 8/30/84 drum site)

See Fig. 14, Area 7

<u>Compound</u>	<u>Results (ppm)</u>
Purgeable Priority Pollutants:	
Trichloroethylene (TCE)	11
Tetrachloroethylene (PCE)	50

# APPENDIX B

**TABLE 1 - SOIL CORES - EAST TRAFFIC CIRCLE LANDFILL**

## ANTIMONY - Total Concentration<sup>a</sup>

TFLC = 500 mg/kg, STLC = 100 mg/kg<sup>b</sup>

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	less than 2
CF3-3B	5 - 5.5	less than 2
CF2-3B	5 - 5.5	2
CF4-3B	5 - 5.5	7
CF6-3B	5 - 5.5	2
CF7-3B	5 - 5.5	11
CF2S-1B	15 - 15.5	7
CF3S-1B	15 - 15.5	less than 2
CF5S-2B	15 - 15.5	less than 2
D2-4B	5 - 5.5	less than 2
D2-5B	5 - 5.5	less than 2
D1-3B	5 - 5.5	less than 2
D1-4B	5 - 5.5	less than 2
D3-3B	5 - 5.5	less than 2
D3-4B	5 - 5.5	2

## ARSENIC - Total Concentration

TFLC = 500 mg/kg, STLC = 5 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	15
CF3-3B	5 - 5.5	16
CF2-3B	5 - 5.5	19
CF4-3B	5 - 5.5	13
CF6-3B	5 - 5.5	14
CF7-3B	5 - 5.5	14
CF2S-1B	15 - 15.5	10
CF3S-1B	15 - 15.5	14
CF5S-2B	15 - 15.5	10
D2-4B	5 - 5.5	11
D2-5B	5 - 5.5	12
D1-3B	5 - 5.5	36
D1-4B	5 - 5.5	27
D3-3B	5 - 5.5	23
D3-4B	5 - 5.5	15

<sup>a</sup> Total Concentration analyses performed and Brown and Caldwell.

<sup>b</sup> These values are the State Hazardous Waste Limits.

**BARIUM - Total Concentration**

TTLc = 10,000 mg/kg, STLC = 100 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	220
CF3-3B	5 - 5.5	190
CF2-3B	5 - 5.5	190
CF4-3B	5 - 5.5	160
CF6-3B	5 - 5.5	250
CF7-3B	5 - 5.5	100
CF2S-1B	15 - 15.5	110
CF3S-1B	15 - 15.5	190
CF5S-2B	15 - 15.5	140
D2-4B	5 - 5.5	140
D2-5B	5 - 5.5	280
D1-3B	5 - 5.5	220
D1-4B	5 - 5.5	200
D3-3B	5 - 5.5	210
D3-4B	5 - 5.5	180

**BERYLLIUM - Total Concentration**

TTLc = 75 mg/kg, STLC = 0.75 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	0.5
CF3-3B	5 - 5.5	0.3
CF2-3B	5 - 5.5	0.3
CF4-3B	5 - 5.5	0.3
CF6-3B	5 - 5.5	0.5
CF7-3B	5 - 5.5	0.2
CF2S-1B	15 - 5.5	0.2
CF3S-1B	15 - 5.5	0.5
CF5S-2B	15 - 5.5	0.3
D2-4B	5 - 5.5	0.3
D2-5B	5 - 5.5	0.4
D1-3B	5 - 5.5	0.4
D1-4B	5 - 5.5	0.4
D3-3B	5 - 5.5	0.4
D3-4B	5 - 5.5	0.3

**CADMIUM - Total Concentration**

**TTLIC = 100 mg/kg, STLC = 1 mg/kg**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	less than 0.1
CF3-3B	5 - 5.5	less than 0.1
CF2-3B	5 - 5.5	less than 0.1
CF4-3B	5 - 5.5	less than 0.2
CF6-3B	5 - 5.5	less than 0.1
CF7-3B	5 - 5.5	less than 0.1
CF2S-1B	15 - 5.5	less than 0.1
CF3S-1B	15 - 5.5	less than 0.1
CF5S-2B	15 - 5.5	less than 0.1
D2-4B	5 - 5.5	less than 0.1
D2-5B	5 - 5.5	less than 0.1
D1-3B	5 - 5.5	less than 0.2
D1-4B	5 - 5.5	less than 0.1
D3-3B	5 - 5.5	less than 0.1
D3-4B	5 - 5.5	less than 0.1

**CHROMIUM - Total Concentration**

**TTLIC = 500 mg/kg, STLC = 5 mg/kg**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	less than 0.2
CF3-3B	5 - 5.5	less than 0.2
CF2-3B	5 - 5.5	less than 0.2
CF4-3B	5 - 5.5	less than 0.2
CF6-3B	5 - 5.5	less than 0.2
CF7-3B	5 - 5.5	less than 0.2
CF2S-1B	15 - 5.5	less than 0.2
CF3S-1B	15 - 5.5	less than 0.2
CF5S-2B	15 - 5.5	less than 0.2
D2-4B	5 - 5.5	less than 0.2
D2-5B	5 - 5.5	less than 0.2
D1-3B	5 - 5.5	less than 0.2
D1-4B	5 - 5.5	less than 0.2
D3-3B	5 - 5.5	less than 0.2
D3-4B	5 - 5.5	less than 0.2

**CHROMIUM (trivalent) - Total Concentration**

TTLC = 2500 mg/kg, STLC = 560 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	28
CF3-3B	5 - 5.5	28
CF2-3B	5 - 5.5	34
CF4-3B	5 - 5.5	45
CF6-3B	5 - 5.5	28
CF7-3B	5 - 5.5	23
CF2S-1B	15 - 15.5	24
CF3S-1B	15 - 15.5	26
CF5S-2B	15 - 15.5	30
D2-4B	5 - 5.5	29
D2-5B	5 - 5.5	27
D1-3B	5 - 5.5	31
D1-4B	5 - 5.5	17
D3-3B	5 - 5.5	33
D3-4B	5 - 5.5	16

**COBALT - Total Concentration**

TTLC = 8000 mg/kg, STLC = 80 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	9.0
CF3-3B	5 - 5.5	6.6
CF2-3B	5 - 5.5	7.5
CF4-3B	5 - 5.5	7.4
CF6-3B	5 - 5.5	9.7
CF7-3B	5 - 5.5	5.6
CF2S-1B	15 - 15.5	5.6
CF3S-1B	15 - 15.5	8.3
CF5S-2B	15 - 15.5	6.6
D2-4B	5 - 5.5	7.6
D2-5B	5 - 5.5	7.8
D1-3B	5 - 5.5	7.1
D1-4B	5 - 5.5	6.9
D3-3B	5 - 5.5	8.3
D3-4B	5 - 5.5	5.6

**COPPER - Total Concentration**

TTLIC = 2500 mg/kg, STLC = 25 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	27
CF3-3B	5 - 5.5	17
CF2-3B	5 - 5.5	18
CF4-3B	5 - 5.5	44
CF6-3B	5 - 5.5	23
CF7-3B	5 - 5.5	40
CF2S-1B	15 - 15.5	20
CF3S-1B	15 - 15.5	22
CF5S-2B	15 - 15.5	14
D2-4B	5 - 5.5	26
D2-5B	5 - 5.5	18
D1-3B	5 - 5.5	20
D1-4B	5 - 5.5	15
D3-3B	5 - 5.5	16
D3-4B	5 - 5.5	12

**LEAD - Total Concentration**

TTLIC = 1000 mg/kg, STLC = 5 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	11
CF3-3B	5 - 5.5	9
CF2-3B	5 - 5.5	9
CF4-3B	5 - 5.5	8
CF6-3B	5 - 5.5	12
CF7-3B	5 - 5.5	6
CF2S-1B	15 - 15.5	5
CF3S-1B	15 - 15.5	9
CF5S-2B	15 - 15.5	7
D2-4B	5 - 5.5	9
D2-5B	5 - 5.5	13
D1-3B	5 - 5.5	10
D1-4B	5 - 5.5	7
D3-3B	5 - 5.5	8
D3-4B	5 - 5.5	5

# MERCURY - Total Concentration

TTLc = 20 mg/kg, STLc = 0.2 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	less than 0.01
CF3-3B	5 - 5.5	less than 0.01
CF2-3B	5 - 5.5	less than 0.01
CF4-3B	5 - 5.5	less than 0.02
CF6-3B	5 - 5.5	less than 0.01
CF7-3B	5 - 5.5	less than 0.01
CF2S-1B	15 - 5.5	less than 0.01
CF3S-1B	15 - 5.5	less than 0.01
CF5S-2B	15 - 5.5	less than 0.01
D2-4B	5 - 5.5	less than 0.01
D2-5B	5 - 5.5	less than 0.01
D1-3B	5 - 5.5	less than 0.02
D1-4B	5 - 5.5	less than 0.01
D3-3B	5 - 5.5	less than 0.1
D3-4B	5 - 5.5	less than 0.1

# MOLYBDENUM - Total Concentration

TTLc = 3500 mg/kg, STLc = 350 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	1
CF3-3B	5 - 5.5	less than 1
CF2-3B	5 - 5.5	less than 1
CF4-3B	5 - 5.5	less than 2
CF6-3B	5 - 5.5	less than 1
CF7-3B	5 - 5.5	less than 1
CF2S-1B	15 - 15.5	1
CF3S-1B	15 - 15.5	less than 1
CF5S-2B	15 - 15.5	1
D2-4B	5 - 5.5	less than 1
D2-5B	5 - 5.5	1
D1-3B	5 - 5.5	less than 1
D1-4B	5 - 5.5	less than 1
D3-3B	5 - 5.5	less than 1
D3-4B	5 - 5.5	less than 1

# NICKEL - Total Concentration

TTLIC = 2000 mg/kg, STLC = 20 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	40
CF3-3B	5 - 5.5	34
CF2-3B	5 - 5.5	46
CF4-3B	5 - 5.5	52
CF6-3B	5 - 5.5	43
CF7-3B	5 - 5.5	39
CF2S-1B	15 - 15.5	35
CF3S-1B	15 - 15.5	38
CF5S-2B	15 - 15.5	35
D2-4B	5 - 5.5	43
D2-5B	5 - 5.5	33
D1-3B	5 - 5.5	43
D1-4B	5 - 5.5	25
D3-3B	5 - 5.5	46
D3-4B	5 - 5.5	24

# SELENIUM - Total Concentration

TTLIC = 100 mg/kg, STLC = 1 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	less than 0.5
CF3-3B	5 - 5.5	less than 0.5
CF2-3B	5 - 5.5	less than 0.5
CF4-3B	5 - 5.5	1
CF6-3B	5 - 5.5	less than 0.5
CF7-3B	5 - 5.5	less than 0.5
CF2S-1B	15 - 5.5	less than 0.5
CF3S-1B	15 - 5.5	less than 0.5
CF5S-2B	15 - 5.5	less than 0.5
D2-4B	5 - 5.5	less than 0.5
D2-5B	5 - 5.5	less than 0.5
D1-3B	5 - 5.5	less than 1
D1-4B	5 - 5.5	less than 0.5
D3-3B	5 - 5.5	less than 0.5
D3-4B	5 - 5.5	less than 0.5

**SILVER - Total Concentration**

TTLC = 500 mg/kg, STLC = 5 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	0.6
CF3-3B	5 - 5.5	0.5
CF2-3B	5 - 5.5	0.4
CF4-3B	5 - 5.5	0.3
CF6-3B	5 - 5.5	0.4
CF7-3B	5 - 5.5	0.4
CF2S-1B	15 - 15.5	0.2
CF3S-1B	15 - 15.5	0.4
CF5S-2B	15 - 15.5	0.3
D2-4B	5 - 5.5	0.3
D2-5B	5 - 5.5	0.8
D1-3B	5 - 5.5	0.6
D1-4B	5 - 5.5	0.4
D3-3B	5 - 5.5	0.4
D3-4B	5 - 5.5	0.4

**THALLIUM - Total Concentration**

TTLC = 700 mg/kg, STLC = 7 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	5
CF3-3B	5 - 5.5	6
CF2-3B	5 - 5.5	5
CF4-3B	5 - 5.5	7
CF6-3B	5 - 5.5	6
CF7-3B	5 - 5.5	4
CF2S-1B	15 - 15.5	4
CF3S-1B	15 - 15.5	6
CF5S-2B	15 - 15.5	5
D2-4B	5 - 5.5	5
D2-5B	5 - 5.5	12
D1-3B	5 - 5.5	6
D1-4B	5 - 5.5	4
D3-3B	5 - 5.5	5
D3-4B	5 - 5.5	3

# **VANADIUM - Total Concentration**

**TTLIC = 2400 mg/kg, STLC = 24 mg/kg**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	28
CF3-3B	5 - 5.5	28
CF2-3B	5 - 5.5	29
CF4-3B	5 - 5.5	32
CF6-3B	5 - 5.5	31
CF7-3B	5 - 5.5	20
CF2S-1B	15 - 15.5	20
CF3S-1B	15 - 15.5	29
CF5S-2B	15 - 15.5	28
D2-4B	5 - 5.5	26
D2-5B	5 - 5.5	36
D1-3B	5 - 5.5	35
D1-4B	5 - 5.5	29
D3-3B	5 - 5.5	29
D3-4B	5 - 5.5	17

# **ZINC - Total Concentration**

**TTLIC = 5000 mg/kg, STLC = 250 mg/kg**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	55
CF3-3B	5 - 5.5	42
CF2-3B	5 - 5.5	46
CF4-3B	5 - 5.5	59
CF6-3B	5 - 5.5	49
CF7-3B	5 - 5.5	43
CF2S-1B	15 - 15.5	34
CF3S-1B	15 - 15.5	49
CF5S-2B	15 - 15.5	35
D2-4B	5 - 5.5	49
D2-5B	5 - 5.5	42
D1-3B	5 - 5.5	53
D1-4B	5 - 5.5	36
D3-3B	5 - 5.5	36
D3-4B	5 - 5.5	29

**FLUORIDE - Total Concentration**

**TFLC = 500 mg/kg, STLC = .5 mg/kg**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	598
CF3-3B	5 - 5.5	495
CF2-3B	5 - 5.5	500
CF4-3B	5 - 5.5	439
<hr/>		
CF6-3B	5 - 5.5	577
CF7-3B	5 - 5.5	172
CF2S-1B	15 - 15.5	344
CF3S-1B	15 - 15.5	296
<hr/>		
CF5S-2B	15 - 15.5	489
D2-4B	5 - 5.5	637
D2-5B	5 - 5.5	778
D1-3B	5 - 5.5	529
<hr/>		
D1-4B	5 - 5.5	454
D3-3B	5 - 5.5	424
D3-4B	5 - 5.5	394

**APPENDIX B**

**TABLE 2 - TOTAL CONCENTRATIONS**

**ANTIMONY - Total Concentration**

TTLC = 500 mg/kg, STLC = 100 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	less than 2
A3-2B	5 - 5.5	less than 2
A4-1B	2 - 2.5	less than 2
A4-2B	5 - 5.5	less than 2
A5-1B	2 - 2.5	less than 2
A5-2B	5 - 5.5	less than 2
A6-1B	2 - 2.5	less than 2
A6-2B	5 - 5.5	less than 2
B5-1B	2 - 2.5	less than 2
B5-2B	5 - 5.5	less than 2
D6-1B	2 - 2.5	less than 2
D6-2B	5 - 5.5	less than 2
D8-1B	2 - 2.5	less than 8
D8-2B	5 - 5.5	less than 4
RW14-1B	2 - 2.5	less than 2
RW14-2B	5 - 5.5	less than 2
RW17-1B	2 - 2.5	less than 2
RW17-2B	5 - 5.5	less than 2
WA3-1B	2 - 2.5	less than 5
WA3-2B	5 - 5.5	less than 2
WA10-1B	2 - 2.5	less than 2
WA10-2B	5 - 5.5	less than 3
UC-1B	2 - 2.5	less than 2
UC-2B	5 - 5.5	less than 2
NR3-1B	2 - 2.5	less than 2
NR3-2B	5 - 5.5	less than 2
NR4-1B	2 - 2.5	less than 2
NR4-2B	5 - 5.5	less than 2
NR5-1B	2 - 2.5	less than 2
NR5-2B	5 - 5.5	less than 2
NR6-1B	2 - 2.5	less than 2
NR6-2B	5 - 5.5	less than 2
NO5-1B	2 - 2.5	less than 3
NO5-2B	5 - 5.5	less than 2
NO6-1B	2 - 2.5	less than 2
NO6-2B	5 - 5.5	less than 2

**ANTIMONY - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO7-1B	2 - 2.5	less than 2
NO7-2B	5 - 5.5	less than 2
TC11-1B	10.5 - 11	less than 2
TC11-2B	15.5 - 16	less than 2
TC12-2B	10 - 10.5	less than 2
SE1-2B	5 - 5.5	less than 2
SE1-3B	10 - 10.5	less than 2
SE2-1B	2 - 2.5	less than 2
SE2-2B	5 - 5.5	less than 2
SE2-3B	10 - 10.5	less than 2
SE3-1B	5 - 5.5	less than 2
SE3-2B	10 - 10.5	less than 2
SE3-3B	15.5 - 16	less than 2

**ARSENIC - Total Concentration**

TTLC = 500 mg/kg, STLC = 5 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	22
A3-2B	5 - 5.5	12
A4-1B	2 - 2.5	9.6
A4-2B	5 - 5.5	8.9
A5-1B	2 - 2.5	29
A5-2B	5 - 5.5	20
A6-1B	2 - 2.5	8.2
A6-2B	5 - 5.5	10
B5-1B	2 - 2.5	30
B5-2B	5 - 5.5	24
D6-1B	2 - 2.5	16
D6-2B	5 - 5.5	20
D8-1B	2 - 2.5	14
D8-2B	5 - 5.5	20
RW14-1B	2 - 2.5	18
RW14-2B	5 - 5.5	17
RW17-1B	2 - 2.5	16
RW17-2B	5 - 5.5	17
WA3-1B	2 - 2.5	15
WA3-2B	5 - 5.5	18

**ARSENIC - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
WA10-1B	2 - 2.5	18
WA10-2B	5 - 5.5	20
UC-1B	2 - 2.5	24
UC-2B	5 - 5.5	20
NR3-1B	2 - 2.5	17
NR3-2B	5 - 5.5	18
NR4-1B	2 - 2.5	24
NR4-2B	5 - 5.5	15
NR5-1B	2 - 2.5	20
NR5-2B	5 - 5.5	19
NR6-1B	2 - 2.5	16
NR6-2B	5 - 5.5	15
NO5-1B	2 - 2.5	19
NO5-2B	5 - 5.5	24
NO6-1B	2 - 2.5	14
NO6-2B	5 - 5.5	18
NO7-1B	2 - 2.5	15
NO7-2B	5 - 5.5	13
TC11-1B	10.5 - 11	18
TC11-2B	15.5 - 16	11
TC12-2B	10 - 10.5	15
SE1-2B	5 - 5.5	19
SE1-3B	10 - 10.5	13
SE2-1B	2 - 2.5	18
SE2-2B	5 - 5.5	15
SE2-3B	10 - 10.5	17
SE3-1B	5 - 5.5	12
SE3-2B	10 - 10.5	9.5
SE3-3B	15.5 - 16	12

**BARIUM - Total Concentration**

TTL C = 10,000 mg/kg, STL C = 100 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	260
A3-2B	5 - 5.5	240
A4-1B	2 - 2.5	170
A4-2B	5 - 5.5	190
A5-1B	2 - 2.5	420
A5-2B	5 - 5.5	250
A6-1B	2 - 2.5	210
A6-2B	5 - 5.5	210
B5-1B	2 - 2.5	200
B5-2B	5 - 5.5	190
D6-1B	2 - 2.5	280
D6-2B	5 - 5.5	300
D8-1B	2 - 2.5	250
D8-2B	5 - 5.5	280
D11-1B	2 - 2.5	240
D11-2B	5 - 5.5	230
GC-1B	2 - 2.5	230
GC-2B	5 - 5.5	200
RW14-1B	2 - 2.5	260
RW14-2B	5 - 5.5	250
RW17-1B	2 - 2.5	220
RW17-2B	5 - 5.5	230
WA3-1B	2 - 2.5	160
WA3-2B	5 - 5.5	130
WA10-1B	2 - 2.5	200
WA10-2B	5 - 5.5	140
UC-1B	2 - 2.5	260
UC-2B	5 - 5.5	240
NR3-1B	2 - 2.5	260
NR3-2B	5 - 5.5	120
NR4-1B	2 - 2.5	280
NR4-2B	5 - 5.5	180
NR5-1B	2 - 2.5	260
NR5-2B	5 - 5.5	190
NR6-1B	2 - 2.5	280
NR6-2B	5 - 5.5	280
NO5-1B	2 - 2.5	220
NO5-2B	5 - 5.5	300
NO6-1B	2 - 2.5	200

**BARIUM - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO6-2B	5 - 5.5	200
NO7-1B	2 - 2.5	180
NO7-2B	5 - 5.5	240
TC11-1B	10.5 - 11	240
TC11-2B	15.5 - 16	180
TC12-2B	10 - 10.5	220
SE1-2B	5 - 5.5	190
SE1-3B	10 - 10.5	200
SE2-1B	2 - 2.5	260
SE2-2B	5 - 5.5	210
SE2-3B	10 - 10.5	200
SE3-1B	5 - 5.5	140
SE3-2B	10 - 10.5	120
SE3-3B	15.5 - 16	210

**BERYLLIUM - Total Concentration**

TTLc = 75 mg/kg, STLc = 0.75 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	0.2
A3-2B	5 - 5.5	0.2
A4-1B	2 - 2.5	0.2
A4-2B	5 - 5.5	0.2
A5-1B	2 - 2.5	0.6
A5-2B	5 - 5.5	0.4
A6-1B	2 - 2.5	0.2
A6-2B	5 - 5.5	0.2
B5-1B	2 - 2.5	less than 0.2
B5-2B	5 - 5.5	less than 0.2
D6-1B	2 - 2.5	0.4
D6-2B	5 - 5.5	0.4
D8-1B	2 - 2.5	0.4
D8-2B	5 - 5.5	0.4
D11-1B	2 - 2.5	0.4
D11-2B	5 - 5.5	0.3

**BERYLLIUM - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
GC-1B	2 - 2.5	0.3
GC-2B	5 - 5.5	0.3
RW14-1B	2 - 2.5	0.4
RW14-2B	5 - 5.5	0.4
RW17-1B	2 - 2.5	0.4
RW17-2B	5 - 5.5	0.4
WA3-1B	2 - 2.5	less than 0.2
WA3-2B	5 - 5.5	less than 0.2
WA10-1B	2 - 2.5	less than 0.2
WA10-2B	5 - 5.5	less than 0.2
UC-1B	2 - 2.5	less than 0.2
UC-2B	5 - 5.5	less than 0.2
NR3-1B	2 - 2.5	less than 0.2
NR3-2B	5 - 5.5	less than 0.2
NR4-1B	2 - 2.5	0.4
NR4-2B	5 - 5.5	less than 0.2
NR5-1B	2 - 2.5	0.4
NR5-2B	5 - 5.5	less than 0.2
NR6-1B	2 - 2.5	less than 0.2
NR6-2B	5 - 5.5	less than 0.2
NO5-1B	2 - 2.5	less than 0.2
NO5-2B	5 - 5.5	0.4
NO6-1B	2 - 2.5	less than 0.2
NO6-2B	5 - 5.5	less than 0.2
NO7-1B	2 - 2.5	less than 0.2
NO7-2B	5 - 5.5	less than 0.2
TC11-1B	10.5 - 11	less than 0.2
TC11-2B	15.5 - 16	less than 0.2
TC12-2B	10 - 10.5	less than 0.2
SE1-2B	5 - 5.5	less than 0.2
SE1-3B	10 - 10.5	less than 0.2
SE2-1B	2 - 2.5	less than 0.2
SE2-2B	5 - 5.5	less than 0.2
SE2-3B	10 - 10.5	less than 0.2
SE3-1B	5 - 5.5	less than 0.2
SE3-2B	10 - 10.5	less than 0.2
SE3-3B	15.5 - 16	less than 0.2

# CADMIUM - Total Concentration

TTLIC = 100 mg/kg, STLC = 1 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	less than 0.1
A3-2B	5 - 5.5	less than 0.1
A4-1B	2 - 2.5	less than 0.1
A4-2B	5 - 5.5	less than 0.1
A5-1B	2 - 2.5	less than 0.1
A5-2B	5 - 5.5	less than 0.1
A6-1B	2 - 2.5	0.4
A6-2B	5 - 5.5	less than 0.1
B5-1B	2 - 2.5	0.6
B5-2B	5 - 5.5	0.8
D6-1B	2 - 2.5	less than 0.2
D6-2B	5 - 5.5	less than 0.1
D8-1B	2 - 2.5	less than 0.1
D8-2B	5 - 5.5	less than 0.1
D11-1B	2 - 2.5	0.6
D11-2B	5 - 5.5	less than 0.1
GC-1B	2 - 2.5	1.4
GC-2B	5 - 5.5	less than 0.1
RW14-1B	2 - 2.5	less than 0.1
RW14-2B	5 - 5.5	less than 0.1
RW17-1B	2 - 2.5	less than 0.1
RW17-2B	5 - 5.5	less than 0.1
WA3-1B	2 - 2.5	less than 0.2
WA3-2B	5 - 5.5	less than 0.2
WA10-1B	2 - 2.5	less than 0.2
WA10-2B	5 - 5.5	less than 0.2
UC-1B	2 - 2.5	0.4
UC-2B	5 - 5.5	less than 0.2
NR3-1B	2 - 2.5	4.4
NR3-2B	5 - 5.5	less than 0.2
NR4-1B	2 - 2.5	less than 0.2
NR4-2B	5 - 5.5	less than 0.2
NR5-1B	2 - 2.5	2.0
NR5-2B	5 - 5.5	less than 0.2
NR6-1B	2 - 2.5	less than 0.2
NR6-2B	5 - 5.5	less than 0.2
NO5-1B	2 - 2.5	less than 0.2
NO5-2B	5 - 5.5	less than 0.2
NO6-1B	2 - 2.5	less than 0.2

**CADMIUM - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO6-2B	5 - 5.5	less than 0.2
NO7-1B	2 - 2.5	less than 0.2
NO7-2B	5 - 5.5	less than 0.2
TC11-1B	10.5 - 11	0.4
TC11-2B	15.5 - 16	less than 0.2
TC12-2B	10 - 10.5	less than 0.2
SE1-2B	5 - 5.5	less than 0.2
SE1-3B	10 - 10.5	less than 0.2
SE2-1B	2 - 2.5	less than 0.2
SE2-2B	5 - 5.5	less than 0.2
SE2-3B	10 - 10.5	less than 0.2
SE3-1B	5 - 5.5	less than 0.2
SE3-2B	10 - 10.5	less than 0.2
SE3-3B	15.5 - 16	less than 0.2

**CHROMIUM (hexavalent) - Total Concentration**

TTLIC = 500 mg/kg, STLC = 5 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	less than 0.2
A3-2B	5 - 5.5	less than 0.2
A4-1B	2 - 2.5	less than 0.2
A4-2B	5 - 5.5	less than 0.2
A5-1B	2 - 2.5	less than 0.2
A5-2B	5 - 5.5	less than 0.2
A6-1B	2 - 2.5	less than 0.2
A6-2B	5 - 5.5	less than 0.2
B5-1B	2 - 2.5	less than 0.2
B5-2B	5 - 5.5	less than 0.2
D6-1B	2 - 2.5	less than 0.2
D6-2B	5 - 5.5	less than 0.2
D8-1B	2 - 2.5	less than 0.2
D8-2B	5 - 5.5	less than 0.2
D11-1B	2 - 2.5	less than 0.2
D11-2B	5 - 5.5	less than 0.2
GC-1B	2 - 2.5	less than 0.2
GC-2B	5 - 5.5	less than 0.2
RW14-1B	2 - 2.5	less than 0.2
RW14-2B	5 - 5.5	less than 0.2

**CHROMIUM (hexavalent) - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
RW17-1B	2 - 2.5	less than 0.2
RW17-2B	5 - 5.5	less than 0.2
WA3-1B	2 - 2.5	less than 0.2
WA3-2B	5 - 5.5	less than 0.2
WA10-1B	2 - 2.5	less than 0.2
WA10-2B	5 - 5.5	less than 0.2
UC-1B	2 - 2.5	less than 0.2
UC-2B	5 - 5.5	less than 0.2
NR3-1B	2 - 2.5	less than 0.2
NR3-2B	5 - 5.5	less than 0.2
NR4-1B	2 - 2.5	less than 0.2
NR4-2B	5 - 5.5	less than 0.2
NR5-1B	2 - 2.5	less than 0.2
NR5-2B	5 - 5.5	less than 0.2
NR6-1B	2 - 2.5	less than 0.2
NR6-2B	5 - 5.5	less than 0.2
NO5-1B	2 - 2.5	less than 0.2
NO5-2B	5 - 5.5	less than 0.2
NO6-1B	2 - 2.5	less than 0.2
NO6-2B	5 - 5.5	less than 0.2
NO7-1B	2 - 2.5	less than 0.2
NO7-2B	5 - 5.5	less than 0.2
TC11-1B	10.5 - 11	less than 0.2
TC11-2B	15.5 - 16	less than 0.2
TC12-2B	10 - 10.5	less than 0.2
SE1-2B	5 - 5.5	less than 0.2
SE1-3B	10 - 10.5	less than 0.2
SE2-1B	2 - 2.5	less than 0.2
SE2-2B	5 - 5.5	less than 0.2
SE2-3B	10 - 10.5	less than 0.2
SE3-1B	5 - 5.5	less than 0.2
SE3-2B	10 - 10.5	less than 0.2
SE3-3B	15.5 - 16	less than 0.2

**CHROMIUM (trivalent) - Total Concentration**

TTLIC = 2500 mg/kg, STLC = 560 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	32
A3-2B	5 - 5.5	28
A4-1B	2 - 2.5	18
A4-2B	5 - 5.5	18
A5-1B	2 - 2.5	33
A5-2B	5 - 5.5	26
A6-1B	2 - 2.5	19
A6-2B	5 - 5.5	18
B5-1B	2 - 2.5	29
B5-2B	5 - 5.5	40
D6-1B	2 - 2.5	30
D6-2B	5 - 5.5	30
D8-1B	2 - 2.5	26
D8-2B	5 - 5.5	29
D11-1B	2 - 2.5	29
D11-2B	5 - 5.5	25
GC-1B	2 - 2.5	33
GC-2B	5 - 5.5	26
RW14-1B	2 - 2.5	27
RW14-2B	5 - 5.5	20
RW17-1B	2 - 2.5	19
RW17-2B	5 - 5.5	19
WA3-1B	2 - 2.5	22
WA3-2B	5 - 5.5	31
WA10-1B	2 - 2.5	25
WA10-2B	5 - 5.5	45
UC-1B	2 - 2.5	38
UC-2B	5 - 5.5	28
NR3-1B	2 - 2.5	50
NR3-2B	5 - 5.5	25
NR4-1B	2 - 2.5	40
NR4-2B	5 - 5.5	40
NR5-1B	2 - 2.5	49
NR5-2B	5 - 5.5	26
NR6-1B	2 - 2.5	28
NR6-2B	5 - 5.5	30
NO5-1B	2 - 2.5	33
NO5-2B	5 - 5.5	30
NO6-1B	2 - 2.5	24
NO6-2B	5 - 5.5	27

CHROMIUM (trivalent) - Total Concentration

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO7-1B	2 - 2.5	23
NO7-2B	5 - 5.5	23
TC11-1B	10.5 - 11	36
TC11-2B	15.5 - 16	24
TC12-2B	10 - 10.5	26
SE1-2B	5 - 5.5	24
SE1-3B	10 - 10.5	22
SE2-1B	2 - 2.5	33
SE2-2B	5 - 5.5	25
SE2-3B	10 - 10.5	30
SE3-1B	5 - 5.5	25
SE3-2B	10 - 10.5	27
SE3-3B	15.5 - 16	19

COBALT - Total Concentration

TTLIC = 8000 mg/kg, STLC = 80 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	9.9
A3-2B	5 - 5.5	7.7
A4-1B	2 - 2.5	8.6
A4-2B	5 - 5.5	8.6
A5-1B	2 - 2.5	9.3
A5-2B	5 - 5.5	9.8
A6-1B	2 - 2.5	8.4
A6-2B	5 - 5.5	6.5
B5-1B	2 - 2.5	6.9
B5-2B	5 - 5.5	6.0
D6-1B	2 - 2.5	8.4
D6-2B	5 - 5.5	8.4
D8-1B	2 - 2.5	7.9
D8-2B	5 - 5.5	9.6
D11-1B	2 - 2.5	8.9
D11-2B	5 - 5.5	7.4
GC-1B	2 - 2.5	7.1
GC-2B	5 - 5.5	6.9
RW14-1B	2 - 2.5	9.6
RW14-2B	5 - 5.5	9.4

**COBALT - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
RW17-1B	2 - 2.5	7.7
RW17-2B	5 - 5.5	8.9
WA3-1B	2 - 2.5	4.9
WA3-2B	5 - 5.5	5.5
WA10-1B	2 - 2.5	6.3
WA10-2B	5 - 5.5	6.9
UC-1B	2 - 2.5	10.0
UC-2B	5 - 5.5	6.3
NR3-1B	2 - 2.5	6.9
NR3-2B	5 - 5.5	10.0
NR4-1B	2 - 2.5	6.3
NR4-2B	5 - 5.5	7.9
NR5-1B	2 - 2.5	7.8
NR5-2B	5 - 5.5	6.4
NR6-1B	2 - 2.5	6.3
NR6-2B	5 - 5.5	7.9
NO5-1B	2 - 2.5	5.5
NO5-2B	5 - 5.5	3.9
NO6-1B	2 - 2.5	4.5
NO6-2B	5 - 5.5	2.9
NO7-1B	2 - 2.5	3.5
NO7-2B	5 - 5.5	3.5
TC11-1B	10.5 - 11	7.3
TC11-2B	15.5 - 16	4.0
TC12-2B	10 - 10.5	3.5
SE1-2B	5 - 5.5	2.0
SE1-3B	10 - 10.5	2.0
SE2-1B	2 - 2.5	2.9
SE2-2B	5 - 5.5	1.9
SE2-3B	10 - 10.5	4.0
SE3-1B	5 - 5.5	2.5
SE3-2B	10 - 10.5	1.6
SE3-3B	15.5 - 16	2.9

**COPPER - Total Concentration**

**TTL C = 2500 mg/kg, STL C = 25 mg/kg**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	23
A3-2B	5 - 5.5	17
A4-1B	2 - 2.5	15
A4-2B	5 - 5.5	16
A5-1B	2 - 2.5	21
A5-2B	5 - 5.5	21
A6-1B	2 - 2.5	120
A6-2B	5 - 5.5	16
B5-1B	2 - 2.5	77
B5-2B	5 - 5.5	150
D6-1B	2 - 2.5	600
D6-2B	5 - 5.5	21
D8-1B	2 - 2.5	18
D8-2B	5 - 5.5	25
D11-1B	2 - 2.5	210
D11-2B	5 - 5.5	19
GC-1B	2 - 2.5	250
GC-2B	5 - 5.5	17
RW14-1B	2 - 2.5	22
RW14-2B	5 - 5.5	20
RW17-1B	2 - 2.5	19
RW17-2B	5 - 5.5	18
WA3-1B	2 - 2.5	21
WA3-2B	5 - 5.5	19
WA10-1B	2 - 2.5	19
WA10-2B	5 - 5.5	18
UC-1B	2 - 2.5	41
UC-2B	5 - 5.5	19
NR3-1B	2 - 2.5	1000
NR3-2B	5 - 5.5	20
NR4-1B	2 - 2.5	26
NR4-2B	5 - 5.5	18
NR5-1B	2 - 2.5	310
NR5-2B	5 - 5.5	19
NR6-1B	2 - 2.5	21
NR6-2B	5 - 5.5	34
NO5-1B	2 - 2.5	20
NO5-2B	5 - 5.5	21
NO6-1B	2 - 2.5	18

**COPPER - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO6-2B	5 - 5.5	17
NO7-1B	2 - 2.5	18
NO7-2B	5 - 5.5	18
TC11-1B	10.5 - 11	26
TC11-2B	15.5 - 16	16
TC12-2B	10 - 10.5	21
SE1-2B	5 - 5.5	15
SE1-3B	10 - 10.5	16
SE2-1B	2 - 2.5	22
SE2-2B	5 - 5.5	20
SE2-3B	10 - 10.5	23
SE3-1B	5 - 5.5	17
SE3-2B	10 - 10.5	15
SE3-3B	15.5 - 16	21

**LEAD - Total Concentration**

TTLc = 1000 mg/kg, STLC = 5 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	13
A3-2B	5 - 5.5	10
A4-1B	2 - 2.5	9
A4-2B	5 - 5.5	9
A5-1B	2 - 2.5	15
A5-2B	5 - 5.5	12
A6-1B	2 - 2.5	91
A6-2B	5 - 5.5	9
B5-1B	2 - 2.5	250
B5-2B	5 - 5.5	1100
D6-1B	2 - 2.5	13000
D6-2B	5 - 5.5	13
D8-1B	2 - 2.5	12
D8-2B	5 - 5.5	12
D11-1B	2 - 2.5	55
D11-2B	5 - 5.5	10
GC-1B	2 - 2.5	360
GC-2B	5 - 5.5	10
RW14-1B	2 - 2.5	12
RW14-2B	5 - 5.5	11

**LEAD - Total Concentration**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
RW17-1B	2 - 2.5	11
RW17-2B	5 - 5.5	10
WA3-1B	2 - 2.5	10
WA3-2B	5 - 5.5	10
WA10-1B	2 - 2.5	10
WA10-2B	5 - 5.5	10
UC-1B	2 - 2.5	69
UC-2B	5 - 5.5	12
NR3-1B	2 - 2.5	180
NR3-2B	5 - 5.5	10
NR4-1B	2 - 2.5	16
NR4-2B	5 - 5.5	10
NR5-1B	2 - 2.5	710
NR5-2B	5 - 5.5	12
NR6-1B	2 - 2.5	12
NR6-2B	5 - 5.5	18
NO5-1B	2 - 2.5	12
NO5-2B	5 - 5.5	14
NO6-1B	2 - 2.5	10
NO6-2B	5 - 5.5	10
NO7-1B	2 - 2.5	10
NO7-2B	5 - 5.5	14
TC11-1B	10.5 - 11	20
TC11-2B	15.5 - 16	8
TC12-2B	10 - 10.5	12
SE1-2B	5 - 5.5	10
SE1-3B	10 - 10.5	14
SE2-1B	2 - 2.5	12
SE2-2B	5 - 5.5	12
SE2-3B	10 - 10.5	14
SE3-1B	5 - 5.5	10
SE3-2B	10 - 10.5	12
SE3-3B	15.5 - 16	12

MERCURY - Total Concentration

TTLIC = 20 mg/kg, STLC = 0.2 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	0.03
A3-2B	5 - 5.5	0.02
A4-1B	2 - 2.5	0.02
A4-2B	5 - 5.5	less than 0.01
A5-1B	2 - 2.5	0.04
A5-2B	5 - 5.5	less than 0.01
A6-1B	2 - 2.5	0.26
A6-2B	5 - 5.5	0.05
B5-1B	2 - 2.5	0.28
B5-2B	5 - 5.5	0.26
D6-1B	2 - 2.5	0.56
D6-2B	5 - 5.5	0.04
D8-1B	2 - 2.5	0.02
D8-2B	5 - 5.5	0.21
D11-1B	2 - 2.5	0.04
D11-2B	5 - 5.5	less than 0.01
GC-1B	2 - 2.5	0.41
GC-2B	5 - 5.5	0.04
RW14-1B	2 - 2.5	0.03
RW14-2B	5 - 5.5	0.07
RW17-1B	2 - 2.5	0.02
RW17-2B	5 - 5.5	0.02
WA3-1B	2 - 2.5	0.60
WA3-2B	5 - 5.5	0.09
WA10-1B	2 - 2.5	less than 0.01
WA10-2B	5 - 5.5	0.04
UC-1B	2 - 2.5	0.24
UC-2B	5 - 5.5	less than 2
NR3-1B	2 - 2.5	1.1
NR3-2B	5 - 5.5	0.04
NR4-1B	2 - 2.5	0.04
NR4-2B	5 - 5.5	0.04
NR5-1B	2 - 2.5	0.52
NR5-2B	5 - 5.5	0.03
NR6-1B	2 - 2.5	0.03
NR6-2B	5 - 5.5	0.04
NO5-1B	2 - 2.5	0.04
NO5-2B	5 - 5.5	0.05
NO6-1B	2 - 2.5	less than 0.01

**MERCURY - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO6-2B	5 - 5.5	0.03
NO7-1B	2 - 2.5	less than 0.01
NO7-2B	5 - 5.5	0.27
TC11-1B	10.5 - 11	0.12
TC11-2B	15.5 - 16	0.05
TC12-2B	10 - 10.5	0.03
SE1-2B	5 - 5.5	0.03
SE1-3B	10 - 10.5	0.02
SE2-1B	2 - 2.5	0.08
SE2-2B	5 - 5.5	0.03
SE2-3B	10 - 10.5	less than 0.01
SE3-1B	5 - 5.5	0.07
SE3-2B	10 - 10.5	0.06
SE3-3B	15.5 - 16	0.04

**MOLYBDENUM - Total Concentration**

TTLC = 3500 mg/kg, STLC = 350 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	less than 1
A3-2B	5 - 5.5	less than 1
A4-1B	2 - 2.5	less than 1
A4-2B	5 - 5.5	less than 1
A5-1B	2 - 2.5	less than 1
A5-2B	5 - 5.5	less than 1
A6-1B	2 - 2.5	less than 1
A6-2B	5 - 5.5	less than 1
B5-1B	2 - 2.5	less than 2
B5-2B	5 - 5.5	less than 2
D6-1B	2 - 2.5	1
D6-2B	5 - 5.5	less than 1
D8-1B	2 - 2.5	less than 1
D8-2B	5 - 5.5	less than 1
D11-1B	2 - 2.5	less than 1
D11-2B	5 - 5.5	less than 1
GC-1B	2 - 2.5	less than 1
GC-2B	5 - 5.5	less than 1
RW14-1B	2 - 2.5	less than 1

**MOLYBDENUM - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
RW14-2B	5 - 5.5	less than 1
RW17-1B	2 - 2.5	less than 1
RW17-2B	5 - 5.5	less than 1
WA3-1B	2 - 2.5	less than 2
WA3-2B	5 - 5.5	less than 2
WA10-1B	2 - 2.5	less than 2
WA10-2B	5 - 5.5	less than 2
UC-1B	2 - 2.5	less than 2
UC-2B	5 - 5.5	less than 2
NR3-1B	2 - 2.5	less than 2
NR3-2B	5 - 5.5	less than 2
NR4-1B	2 - 2.5	less than 2
NR4-2B	5 - 5.5	less than 2
NR5-1B	2 - 2.5	less than 2
NR5-2B	5 - 5.5	less than 2
NR6-1B	2 - 2.5	less than 2
NR6-2B	5 - 5.5	less than 2
NO5-1B	2 - 2.5	less than 2
NO5-2B	5 - 5.5	less than 2
NO6-1B	2 - 2.5	less than 2
NO6-2B	5 - 5.5	less than 2
NO7-1B	2 - 2.5	less than 2
NO7-2B	5 - 5.5	less than 2
TC11-1B	10.5 - 11	less than 2
TC11-2B	15.5 - 16	less than 2
TC12-2B	10 - 10.5	less than 2
SE1-2B	5 - 5.5	less than 2
SE1-3B	10 - 10.5	less than 2
SE2-1B	2 - 2.5	less than 2
SE2-2B	5 - 5.5	less than 2
SE2-3B	10 - 10.5	less than 2
SE3-1B	5 - 5.5	less than 2
SE3-2B	10 - 10.5	less than 2
SE3-3B	15.5 - 16	less than 2

NICKEL - Total Concentration

TTLIC = 2000 mg/kg, STLC = 20 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	50
A3-2B	5 - 5.5	35
A4-1B	2 - 2.5	32
A4-2B	5 - 5.5	31
A5-1B	2 - 2.5	62
A5-2B	5 - 5.5	42
A6-1B	2 - 2.5	35
A6-2B	5 - 5.5	36
B5-1B	2 - 2.5	53
B5-2B	5 - 5.5	57
D6-1B	2 - 2.5	54
D6-2B	5 - 5.5	52
D8-1B	2 - 2.5	42
D8-2B	5 - 5.5	49
D11-1B	2 - 2.5	51
D11-2B	5 - 5.5	40
GC-1B	2 - 2.5	49
GC-2B	5 - 5.5	40
RW14-1B	2 - 2.5	46
RW14-2B	5 - 5.5	39
RW17-1B	2 - 2.5	39
RW17-2B	5 - 5.5	36
WA3-1B	2 - 2.5	32
WA3-2B	5 - 5.5	55
WA10-1B	2 - 2.5	41
WA10-2B	5 - 5.5	53
UC-1B	2 - 2.5	63
UC-2B	5 - 5.5	46
NR3-1B	2 - 2.5	59
NR3-2B	5 - 5.5	47
NR4-1B	2 - 2.5	71
NR4-2B	5 - 5.5	50
NR5-1B	2 - 2.5	79
NR5-2B	5 - 5.5	40
NR6-1B	2 - 2.5	52
NR6-2B	5 - 5.5	51
NO5-1B	2 - 2.5	43
NO5-2B	5 - 5.5	53
NO6-1B	2 - 2.5	35

NICKEL - Total Concentration (continued)

TTLIC = 500 mg/kg, STLC = 100 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO6-2B	5 - 5.5	41
NO7-1B	2 - 2.5	35
NO7-2B	5 - 5.5	39
TC11-1B	10.5 - 11	71
TC11-2B	15.5 - 16	36
TC12-2B	10 - 10.5	39
SE1-2B	5 - 5.5	34
SE1-3B	10 - 10.5	35
SE2-1B	2 - 2.5	52
SE2-2B	5 - 5.5	40
SE2-3B	10 - 10.5	48
SE3-1B	5 - 5.5	35
SE3-2B	10 - 10.5	37
SE3-3B	15.5 - 16	39

SELENIUM - Total Concentration

TTLIC = 100 mg/kg, STLC = 1 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	less than 1
A3-2B	5 - 5.5	less than 1
A4-1B	2 - 2.5	less than 1
A4-2B	5 - 5.5	less than 1
A5-1B	2 - 2.5	less than 1
A5-2B	5 - 5.5	less than 1
A6-1B	2 - 2.5	less than 1
A6-2B	5 - 5.5	less than 1
B5-1B	2 - 2.5	less than 2
B5-2B	5 - 5.5	less than 2
D6-1B	2 - 2.5	less than 1
D6-2B	5 - 5.5	less than 1
D8-1B	2 - 2.5	less than 1
D8-2B	5 - 5.5	less than 1
D11-1B	2 - 2.5	less than 1
D11-2B	5 - 5.5	less than 1
GC-1B	2 - 2.5	less than 1
GC-2B	5 - 5.5	less than 1

**SELENIUM - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
RW14-1B	2 - 2.5	less than 1
RW14-2B	5 - 5.5	less than 1
RW17-1B	2 - 2.5	less than 1
RW17-2B	5 - 5.5	less than 1
WA3-1B	2 - 2.5	less than 2
WA3-2B	5 - 5.5	less than 2
WA10-1B	2 - 2.5	less than 2
WA10-2B	5 - 5.5	less than 3
UC-1B	2 - 2.5	less than 2
UC-2B	5 - 5.5	less than 2
NR3-1B	2 - 2.5	less than 2
NR3-2B	5 - 5.5	less than 2
NR4-1B	2 - 2.5	less than 2
NR4-2B	5 - 5.5	less than 2
NR5-1B	2 - 2.5	less than 2
NR5-2B	5 - 5.5	less than 2
NR6-1B	2 - 2.5	less than 2
NR6-2B	5 - 5.5	less than 2
NO5-1B	2 - 2.5	less than 3
NO5-2B	5 - 5.5	less than 2
NO6-1B	2 - 2.5	less than 2
NO6-2B	5 - 5.5	less than 2
NO7-1B	2 - 2.5	less than 2
NO7-2B	5 - 5.5	less than 2
TC11-1B	10.5 - 11	less than 2
TC11-2B	15.5 - 16	less than 2
TC12-2B	10 - 10.5	less than 2
SE1-2B	5 - 5.5	less than 2
SE1-3B	10 - 10.5	less than 2
SE2-1B	2 - 2.5	less than 2
SE2-2B	5 - 5.5	less than 2
SE2-3B	10 - 10.5	less than 2
SE3-1B	5 - 5.5	less than 2
SE3-2B	10 - 10.5	less than 2
SE3-3B	15.5 - 16	less than 2

# SILVER - Total Concentration

TTLIC = 500 mg/kg, STLC = 5 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	0.4
A3-2B	5 - 5.5	0.5
A4-1B	2 - 2.5	0.2
A4-2B	5 - 5.5	0.3
A5-1B	2 - 2.5	0.6
A5-2B	5 - 5.5	0.4
A6-1B	2 - 2.5	0.8
A6-2B	5 - 5.5	0.3
B5-1B	2 - 2.5	1.4
B5-2B	5 - 5.5	3.2
D6-1B	2 - 2.5	5.3
D6-2B	5 - 5.5	0.6
D8-1B	2 - 2.5	0.4
D8-2B	5 - 5.5	0.5
D11-1B	2 - 2.5	1.3
D11-2B	5 - 5.5	0.5
GC-1B	2 - 2.5	5.6
GC-2B	5 - 5.5	0.4
RW14-1B	2 - 2.5	0.4
RW14-2B	5 - 5.5	0.5
RW17-1B	2 - 2.5	0.5
RW17-2B	5 - 5.5	0.5
WA3-1B	2 - 2.5	0.4
WA3-2B	5 - 5.5	0.6
WA10-1B	2 - 2.5	0.4
WA10-2B	5 - 5.5	less than 0.2
UC-1B	2 - 2.5	2.2
UC-2B	5 - 5.5	0.6
NR3-1B	2 - 2.5	2.8
NR3-2B	5 - 5.5	0.4
NR4-1B	2 - 2.5	0.8
NR4-2B	5 - 5.5	0.6
NR5-1B	2 - 2.5	4.1
NR5-2B	5 - 5.5	0.4
NR6-1B	2 - 2.5	0.6
NR6-2B	5 - 5.5	1.0
NO5-1B	2 - 2.5	0.6
NO5-2B	5 - 5.5	0.4
NO6-1B	2 - 2.5	0.4

**SILVER - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO6-2B	5 - 5.5	0.4
NO7-1B	2 - 2.5	less than 0.2
NO7-2B	5 - 5.5	0.6
TC11-1B	10.5 - 11	0.8
TC11-2B	15.5 - 16	0.6
TC12-2B	10 - 10.5	0.4
SE1-2B	5 - 5.5	0.4
SE1-3B	10 - 10.5	less than 0.2
SE2-1B	2 - 2.5	0.6
SE2-2B	5 - 5.5	less than 0.2
SE2-3B	10 - 10.5	0.4
SE3-1B	5 - 5.5	less than 0.2
SE3-2B	10 - 10.5	less than 0.2
SE3-3B	15.5 - 16	0.6

**THALLIUM - Total Concentration**

TTLC = 700 mg/kg, STLC = 7 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	7
A3-2B	5 - 5.5	6
A4-1B	2 - 2.5	6
A4-2B	5 - 5.5	6
A5-1B	2 - 2.5	8
A5-2B	5 - 5.5	6
A6-1B	2 - 2.5	5
A6-2B	5 - 5.5	5
B5-1B	2 - 2.5	8
B5-2B	5 - 5.5	6
D6-1B	2 - 2.5	6
D6-2B	5 - 5.5	6
D8-1B	2 - 2.5	6
D8-2B	5 - 5.5	7
D11-1B	2 - 2.5	5
D11-2B	5 - 5.5	6
GC-1B	2 - 2.5	5
GC-2B	5 - 5.5	5

**THALLIUM - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
RW14-1B	2 - 2.5	6
RW14-2B	5 - 5.5	7
RW17-1B	2 - 2.5	6
RW17-2B	5 - 5.5	7
WA3-1B	2 - 2.5	7
WA3-2B	5 - 5.5	4
WA10-1B	2 - 2.5	4
WA10-2B	5 - 5.5	4
UC-1B	2 - 2.5	8
UC-2B	5 - 5.5	8
NR3-1B	2 - 2.5	8
NR3-2B	5 - 5.5	8
NR4-1B	2 - 2.5	10
NR4-2B	5 - 5.5	8
NR5-1B	2 - 2.5	8
NR5-2B	5 - 5.5	8
NR6-1B	2 - 2.5	6
NR6-2B	5 - 5.5	10
NO5-1B	2 - 2.5	8
NO5-2B	5 - 5.5	6
NO6-1B	2 - 2.5	8
NO6-2B	5 - 5.5	8
NO7-1B	2 - 2.5	8
NO7-2B	5 - 5.5	8
TC11-1B	10.5 - 11	8
TC11-2B	15.5 - 16	4
TC12-2B	10 - 10.5	8
SE1-2B	5 - 5.5	8
SE1-3B	10 - 10.5	6
SE2-1B	2 - 2.5	8
SE2-2B	5 - 5.5	6
SE2-3B	10 - 10.5	8
SE3-1B	5 - 5.5	6
SE3-2B	10 - 10.5	4
SE3-3B	15.5 - 16	6

**VANADIUM - Total Concentration**

TTLC = 2400 mg/kg, STLC = 24 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	27
A3-2B	5 - 5.5	23
A4-1B	2 - 2.5	21
A4-2B	5 - 5.5	21
A5-1B	2 - 2.5	20
A5-2B	5 - 5.5	24
A6-1B	2 - 2.5	18
A6-2B	5 - 5.5	17
B5-1B	2 - 2.5	24
B5-2B	5 - 5.5	28
D6-1B	2 - 2.5	26
D6-2B	5 - 5.5	29
D8-1B	2 - 2.5	18
D8-2B	5 - 5.5	27
D11-1B	2 - 2.5	23
D11-2B	5 - 5.5	23
GC-1B	2 - 2.5	26
GC-2B	5 - 5.5	17
RW14-1B	2 - 2.5	24
RW14-2B	5 - 5.5	23
RW17-1B	2 - 2.5	18
RW17-2B	5 - 5.5	20
WA3-1B	2 - 2.5	16
WA3-2B	5 - 5.5	23
WA10-1B	2 - 2.5	24
WA10-2B	5 - 5.5	18
UC-1B	2 - 2.5	28
UC-2B	5 - 5.5	28
NR3-1B	2 - 2.5	28
NR3-2B	5 - 5.5	16
NR4-1B	2 - 2.5	28
NR4-2B	5 - 5.5	18
NR5-1B	2 - 2.5	28
NR5-2B	5 - 5.5	22
NR6-1B	2 - 2.5	18
NR6-2B	5 - 5.5	16
NO5-1B	2 - 2.5	27
NO5-2B	5 - 5.5	24
NO6-1B	2 - 2.5	16

**VANADIUM - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO6-2B	5 - 5.5	28
NO7-1B	2 - 2.5	18
NO7-2B	5 - 5.5	18
TC11-1B	10.5 - 11	24
TC11-2B	15.5 - 16	16
TC12-2B	10 - 10.5	18
SE1-2B	5 - 5.5	18
SE1-3B	10 - 10.5	16
SE2-1B	2 - 2.5	23
SE2-2B	5 - 5.5	17
SE2-3B	10 - 10.5	22
SE3-1B	5 - 5.5	16
SE3-2B	10 - 10.5	12
SE3-3B	15.5 - 16	12

**ZINC - Total Concentration**

TTLC = 5000 mg/kg, STLC = 250 mg/kg

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	46
A3-2B	5 - 5.5	39
A4-1B	2 - 2.5	28
A4-2B	5 - 5.5	30
A5-1B	2 - 2.5	49
A5-2B	5 - 5.5	43
A6-1B	2 - 2.5	110
A6-2B	5 - 5.5	37
B5-1B	2 - 2.5	370
B5-2B	5 - 5.5	280
D6-1B	2 - 2.5	450
D6-2B	5 - 5.5	47
D8-1B	2 - 2.5	40
D8-2B	5 - 5.5	46
D11-1B	2 - 2.5	260
D11-2B	5 - 5.5	42
GC-1B	2 - 2.5	200
GC-2B	5 - 5.5	43
RW14-1B	2 - 2.5	46
RW14-2B	5 - 5.5	47

**ZINC - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
RW17-1B	2 - 2.5	43
RW17-2B	5 - 5.5	40
WA3-1B	2 - 2.5	39
WA3-2B	5 - 5.5	51
WA10-1B	2 - 2.5	43
WA10-2B	5 - 5.5	43
UC-1B	2 - 2.5	91
UC-2B	5 - 5.5	42
NR3-1B	2 - 2.5	460
NR3-2B	5 - 5.5	45
NR4-1B	2 - 2.5	63
NR4-2B	5 - 5.5	41
NR5-1B	2 - 2.5	430
NR5-2B	5 - 5.5	44
NR6-1B	2 - 2.5	44
NR6-2B	5 - 5.5	63
NO5-1B	2 - 2.5	45
NO5-2B	5 - 5.5	43
NO6-1B	2 - 2.5	37
NO6-2B	5 - 5.5	39
NO7-1B	2 - 2.5	35
NO7-2B	5 - 5.5	37
TC11-1B	10.5 - 11	69
TC11-2B	15.5 - 16	36
TC12-2B	10 - 10.5	45
SE1-2B	5 - 5.5	32
SE1-3B	10 - 10.5	37
SE2-1B	2 - 2.5	50
SE2-2B	5 - 5.5	44
SE2-3B	10 - 10.5	52
SE3-1B	5 - 5.5	31
SE3-2B	10 - 10.5	35
SE3-3B	15.5 - 16	45

**FLUORIDE - Total Concentration**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	179
A3-2B	5 - 5.5	120
A4-1B	2 - 2.5	92
A4-2B	5 - 5.5	87
A5-1B	2 - 2.5	142
A5-2B	5 - 5.5	26
A6-1B	2 - 2.5	88
A6-2B	5 - 5.5	26
B5-1B	2 - 2.5	273
B5-2B	5 - 5.5	64
D6-1B	2 - 2.5	168
D6-2B	5 - 5.5	219
D8-1B	2 - 2.5	136
D8-2B	5 - 5.5	129
D11-1B	2 - 2.5	115
D11-2B	5 - 5.5	154
GC-1B	2 - 2.5	219
GC-2B	5 - 5.5	221
RW14-1B	2 - 2.5	185
RW14-2B	5 - 5.5	198
RW17-1B	2 - 2.5	186
RW17-2B	5 - 5.5	175
WA3-1B	2 - 2.5	218
WA3-2B	5 - 5.5	284
WA10-1B	2 - 2.5	237
WA10-2B	5 - 5.5	224
UC-1B	2 - 2.5	239
UC-2B	5 - 5.5	2054
NR3-1B	2 - 2.5	261
NR3-2B	5 - 5.5	214
NR4-1B	2 - 2.5	144
NR4-2B	5 - 5.5	152
NR5-1B	2 - 2.5	124
NR5-2B	5 - 5.5	159
NR6-1B	2 - 2.5	131
NR6-2B	5 - 5.5	317
NO5-1B	2 - 2.5	290
NO5-2B	5 - 5.5	265
NO6-1B	2 - 2.5	110
NO6-2B	5 - 5.5	150

**FLUORIDE - Total Concentration (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
NO7-1B	2 - 2.5	110
NO7-2B	5 - 5.5	180
TC11-1B	10.5 - 11	192
TC11-2B	15.5 - 16	325
TC12-2B	10 - 10.5	230
SE1-2B	5 - 5.5	190
SE1-3B	10 - 10.5	230
SE2-1B	2 - 2.5	230
SE2-2B	5 - 5.5	330
SE2-3B	10 - 10.5	450
SE3-1B	5 - 5.5	300
SE3-2B	10 - 10.5	240
SE3-3B	15.5 - 16	290

**APPENDIX B**

**TABLE 3 - TOTAL PCBs**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
CF1-3B	5 - 5.5	0.14
CF3-3B	5 - 5.5	less than 0.05
CF2-3B	5 - 5.5	0.25
CF4-3B	5 - 5.5	0.05
CF6-3B	5 - 5.5	0.05
CF7-3B	5 - 5.5	1.4
CF2S-1B	15 - 5.5	0.17
CF3S-1B	15 - 5.5	0.05
CF5S-2B	15 - 5.5	less than 0.05
D2-4B	5 - 5.5	less than 0.05
D2-5B	5 - 5.5	0.06
D1-3B	5 - 5.5	less than 0.05
D1-4B	5 - 5.5	less than 0.05
D3-3B	5 - 5.5	less than 0.05
D3-4B	5 - 5.5	less than 0.05

**APPENDIX B**

**TABLE 4 - TOTAL PCBs**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
A3-1B	2 - 2.5	less than 0.05
A3-2B	5 - 5.5	less than 0.05
A4-1B	2 - 2.5	less than 0.05
A4-2B	5 - 5.5	less than 0.05
A5-1B	2 - 2.5	less than 0.05
A5-2B	5 - 5.5	less than 0.05
A6-1B	2 - 2.5	1.8
A6-2B	5 - 5.5	less than 0.05
B5-1B	2 - 2.5	less than 0.05
B5-2B	5 - 5.5	0.19
D6-1B	2 - 2.5	0.75
D6-2B	5 - 5.5	less than 0.05
D8-1B	2 - 2.5	less than 0.05
D8-2B	5 - 5.5	less than 0.05
D11-1B	2 - 2.5	less than 0.05
D11-2B	5 - 5.5	less than 0.05
GC-1B	2 - 2.5	310
GC-2B	5 - 5.5	less than 0.05
RW14-1B	2 - 2.5	0.05
RW14-2B	5 - 5.5	less than 0.05
RW17-1B	2 - 2.5	less than 0.05
RW17-2B	5 - 5.5	less than 0.05
WA3-1B	2 - 2.5	21.1
WA3-2B	5 - 5.5	less than 0.05
WA10-1B	2 - 5.5	less than 0.05
WA10-2B	5 - 5.5	less than 0.05
UC-1B	2 - 2.5	5.19
UC-2B	5 - 5.5	less than 0.05
NR3-1B	2 - 2.5	2.08
NR3-2B	5 - 5.5	less than 0.05
NR4-1B	2 - 2.5	less than 0.05
NR4-2B	5 - 5.5	less than 0.05
N05-1B	2 - 2.5	less than 0.05
N05-2B	5 - 5.5	less than 0.05

**TOTAL PCBs (continued)**

<u>Core Number</u>	<u>Sample Depth (ft)</u>	<u>Concentration (mg/kg)</u>
N06-1B	2 - 2.5	less than 0.05
N06-2B	5 - 5.5	less than 0.05
N07-1B	2 - 2.5	less than 0.05
N07-2B	5 - 5.5	less than 0.05
TC11-1B	10.5 - 11	1.15
TC11-2B	15.5 - 16	less than 0.05
TC12-2B	10 - 10.5	less than 0.05
SE1-2B	5 - 5.5	less than 0.05
SE1-3B	10 - 10.5	less than 0.05
SE2-1B	2 - 2.5	less than 0.05
SE2-2B	5 - 5.5	less than 0.05
SE2-3B	10 - 10.5	less than 0.05
SE3-1B	5 - 5.5	less than 0.05
SE3-2B	10 - 10.5	less than 0.05
SE3-3B	15.5 - 16	less than 0.05

# APPENDIX B

## TABLE 5 - CALIFORNIA WASTE EXTRACTION TEST\*

<u>Element</u>	<u>A3-1B</u>	<u>A4-2B</u>	<u>A5-1B</u>
ARSENIC	less than 0.01	less than 0.01	less than 0.01
BARIUM	12	7.4	13
COPPER	NA	NA	NA
LEAD	less than 0.1	less than 0.1	less than 0.1
MERCURY	NA	NA	NA
NICKEL	0.73	0.77	1.2
THALLIUM	less than 0.1	NA	less than 0.1
VANADIUM	0.4	NA	NA

<u>ELEMENT</u>	<u>A6-1B</u>	<u>D8-2B</u>	<u>RW14-2B</u>	<u>STLC</u>
ARSENIC	less than 0.01	less than 0.01	less than 0.01	5.0
BARIUM	7.4	12	12	100
COPPER	2.8	2.8	NA	25
LEAD	0.9	less than 0.1	0.1	5.0
MERCURY	NA	NA	NA	0.2
NICKEL	0.95	0.86	0.70	20
THALLIUM	NA	less than 0.1	less than 0.1	7.0
VANADIUM	NA	0.4	NA	24

\* Soluble threshold limit concentration as specified in the California Assessment Manual (CAM), Criteria for Identification of Hazardous and Extremely Hazardous Wastes. Draft of January 11, 1984.

NA not analyzed

Analysis was performed for CAM metals where the TTLC concentration exceeded the CAM STLC threshold.



Permanent Data Record  
January 3, 1985

TABLE 3-C

Location	Probe Response mv	PCB Arochlor 1242 ppm
13-1	159	40 *
13-2	167	40
13-3	168	40
13-4	149	40
13-5	159	40
13-6	159	40
13-7	155	40
13-8	157	40
13-9	150	40
3-1	142	40
3-2	151	40
3-3	145	40
3-4	145	40
3-5	152	40
15-1	158	40
15-2	150	40
3-6	152	40
3-7	145	40
3-8	150	40
3-9	127	44
3-10	150	40
3-11	115	72
3-12	132	40
3-13	150	40
3-14	151	40
3-15	147	40
3-16	147	40
3-17	155	40

\* All results reported as 40 ppm in this column are actually less than the detection limit (i.e., less than 40 ppm).

# APPENDIX C

**TABLE 2 - POLYCHLORINATED BIPHENYL (PCB) ANALYSIS OF SOIL**

Date Sampled: 8/29/84  
 Date Sampled: 9/11/84  
 Date Received: 9/12/84  
 Date Extracted: 9/12/84

<u>Log Number</u>	<u>Sample Description</u>	<u>Results</u>
9-84-01	EA-1	Aroclor 1254: 0.2 Aroclor 1260: 0.2 Total: 0.2
9-84-06	EA-6	Aroclor 1254: 9.3 Aroclor 1260: 2.3 Total: 12
9-84-07	TC-9	Aroclor 1254: 0.2 Aroclor 1260: 0.2 Total: 0.4
9-84-08	TC-10	Aroclor 1254: 17 Aroclor 1260: 3.0 Total: 20
9-84-09	WA-1	Aroclor 1254: 3.0 Aroclor 1260: 2.3 Total: 5.3
9-84-10	WA-2	Aroclor 1254: 5.3 Aroclor 1260: 3.3 Total: 8.6
9-84-11	WA-3	Aroclor 1254: 10 Aroclor 1260: 4.6 Total: 15
9-84-12	WA-4	Aroclor 1254: 9.5 Aroclor 1260: 1.6 Total: 11
9-84-13	WA-5	Aroclor 1254: 1.7 Aroclor 1260: 0.6 Total: 2.3
9-84-14	WA-6	Aroclor 1254: 6.2 Aroclor 1260: 1.2 Total: 7.4
9-84-15	WA-7	Aroclor 1254: 5.8 Aroclor 1260: 1.6 Total: 7.4

<u>Log Number</u>	<u>Sample Description</u>	<u>Results</u>
9-84-16	WA-8	Aroclor 1254: 2.8 Aroclor 1260: 0.6 Total: 3.4
9-84-17	WA-9	Aroclor 1254: 13 Aroclor 1260: 3.0 Total: 16
9-84-18	WA-10	Aroclor 1254: 17 Aroclor 1260: 3.5 Total: 20



# APPENDIX D

TABLE 1 - RESULTS OF POST-CLEANUP SAMPLES

Location of samples found on Fig. 30.

Sample date: September 10, 1985

<u>LLNL #</u>	<u>B &amp; C #</u>	<u>Copper</u>	<u>Lead</u>	<u>Zinc</u>	<u>PCB</u>
PM-1	PL-1	18	10	40	
PM-2	PL-2	25	14	50	
PM-3	PL-3	62	29	86	
PM-4	PL-4	210	55	160	
PM-5	PL-5	91	40	120	
PM-6	PL-6	65	54	150	
PM-7	PL-7	91	18	110	
PM-8	PL-8	35	18	55	
PM-9	PL-9	21	11	44	
PM-10	PL-10	48	29	82	
PM-11	PL-11	38	30	68	
PM-12	PL-12	130	59	170	
PM-13	PL-13	41	33	76	
PM-14	PL-14	19	13	38	
PM-15	PL-15	850	110	780	
PM-16	PL-16	440	81	260	
PM-17	PL-17	16	10	33	
PM-18	PL-18	18	11	37	
PM-19	PL-19	19	11	40	
PM-20	PL-20	39	31	77	
PM-21	PL-21	2100	240	510	
PM-22	PL-22	21	14	41	
PM-23	PL-23	30	11	51	5.9
PM-24	PL-24	17	11	36	1.7
PM-25	PL-25	20	14	43	
PM-26	PL-26	16	10	34	
PM-27	PL-27	14	10	33	
PM-28	PL-28	18	16	44	0.7
PM-29	PL-29	16	13	36	2.2
PM-30	PL-30	140	47	130	4.0
PM-31	PL-31	29	19	52	
PM-32	PL-32	40	28	74	4.0

# APPENDIX D

**TABLE 1 RESULTS OF POST-cleanup samples (continued)**

<u>LLNL #</u>	<u>B &amp; C #</u>	<u>Copper</u>	<u>Lead</u>	<u>Zinc</u>	<u>PCB</u>
PM-33	PL-33	27	16	55	
M-1-1	PL-34	46	23	68	
M-1-2	PL-35	19	14	39	
PCB-2-1	PL-36	1400	560	940	4.0
PCB-2-2	PL-37	140	49	120	9.6
M-3-1	PL-38	39	22	65	8.4
M-3-2	PL-39	33	10	41	0.7
M-3-3	PL-40	21	14	75	1.4
M-6-1	PL-41	18	12	37	
M-6-2	PL-42	18	12	39	
M-7-1	PL-43	18	10	36	
M-7-2	PL-44	100	110	210	
M-14-1	PL-45	15	8	35	
M-14-2	PL-46	1000	410	410	
M-14-3	PL-47	36	28	70	
PCB-15-1	PL-48	28	16	57	5.4
PCB-15-2	PL-49				1.0
<u>TTL</u>	<u>STLC X 10</u>				
Copper	2500	250			
Lead	1000	50			
Zinc	5000	250			

# APPENDIX E

## TABLE 1 - LLNL SOIL SIEVE ANALYSIS

<u>Sample #1</u>		<u>Sample #2</u>	
<u>Sieve Size</u>	<u>Percent Passing</u>	<u>Sieve Size</u>	<u>Percent Passing</u>
2.0"	100	2.0"	100
1.5"	99.2	1.5"	98.8
1.0"	98.0	1.0"	95.5
0.75"	97.1	0.75"	91.8
0.5"	94.5	0.5"	82.5
0.375"	92.6	0.375"	76.4
#4	83.4	#4	63.9
#8	83.4	#8	56.8
#16	80.7	#16	51.7
#30	77.6	#30	47.6
#50	72.0	#50	41.9
#100	62.8	#100	35.1
#200	51.4	#200	28.1

# APPENDIX E

## TABLE 2 - IMPORT SOIL SIEVE ANALYSIS

<u>Sieve Size</u>	<u>Percent Passing</u>
0.375"	100
#4	99
#8	98
#16	97
#30	95
#50	89
#100	72
#200	52



## APPENDIX F

Table 1 - TRAFFIC CIRCLE SAMPLE AND ANALYSES

Date Sampled: 8/23/84

### Sample Description

#### Solid Sample

MP-818; 8/20/84

MP-818; 8/20/84

MP-819; 8/20/84

California Assessment Manual (CAM)

Concentration: mg/L

	8-286-1	STLC
Antimony	0.5	15.0
Arsenic	0.01*	5.0
Barium	8.0	100.0
Beryllium	0.04	0.75
Cadmium	6.4	1.0
Chromium, Hexavalent	0.001*	5.0
Chromium, Trivalent	0.60	560.0
Cobalt	1.0	80.0
Copper	290.0	25.0
Lead	94.0	5.0
Mercury	0.015	0.2
Molybdenum	0.5	550.0
Nickel	4.5	20.0
Selenium	0.01*	1.0
Silver	0.13	5.0
Thallium	0.1*	7.0
Vanadium	0.5	24.0
Zinc	240.0	250.0

\* Less than this concentration.

## Appendix F

**Table 1 - TRAFFIC CIRCLE SAMPLE AND ANALYSIS (continued)**

Date Sampled: 10/08/84

Samples found in Figs. F-2 and F-3

ST1	Fig. F-3
ST2	Fig. F-3
ST3	Fig. F-2
ST4	Fig. F-2
ST5	Fig. F-2

California Assessment Manual (CAM)

	Concentration mg/Kg					STLC*
	10-83-12	10-83-13	10-83-14	10-83-15	10-83-16	
Copper	2.2	9.0	38.0	65.0	91.0	25.0
Lead	0.6	0.7	32.0	25.0	98.0	5.0
Mercury	0.001	0.001	0.003	0.006	0.007	0.2

\* Soluble Threshold Concentration as specified in the California Assessment Manual (CAM), Criteria for Identification of Hazardous and Extremely Hazardous Wastes. Draft of January 11, 1984.

# APPENDIX F

**TABLE 1 - TRAFFIC CIRCLE SAMPLE AND ANALYSES (continued)**

Date Sampled: 10/08/84

Sample Description

Soil samples found in Figs. F-1, F-3, and F-7

TT1 Fig. F-7  
TT2 Fig. F-1  
TT3 Fig. F-3  
TT4 Fig. F-3  
TT5 Fig. F-3

California Assessment Manual (CAM)

Concentration: mg/Kg

CAM METALS	10-83-1	10-83-2	10-83-3	10-83-4	10-83-5	TTL
Antimony *	2.0	2.0	2.0	2.0	2.0	500
Arsenic	17.0	13.0	19.0	19.0	17.0	500
Barium	280.0	220.0	290.0	260.0	270.0	10,000
Beryllium	0.6	0.4	0.6	0.5	0.4	75
Cadmium	5.4	0.4	0.6	0.3	0.2 *	100
Chromium, Hexavalent *	0.4	0.4	0.4	0.4	0.4	500
Chromium, Trivalent	48.0	32.0	34.0	33.0	30.0	2500
Cobalt	13.0	14.0	13.0	14.0	14.0	8000
Copper	1500.0	220.0	54.0	60.0	48.0	2500
Lead	260.0	61.0	21.0	21.0	13.0	1000
Mercury	1.6	0.26	0.64	0.52	0.12	12
Molybdenum *	2.0	2.0	2.0	2.0	2.0	3500
Nickel	69.0	63.0	54.0	54.0	49.0	2000
Selenium *	2.0	2.0	0.0	2.0	2.0	100
Silver	2.2	0.6	1.3	1.6	0.8	500
Thallium	4.0	4.0	4.0	5.0	8.0	700
Vanadium	43.0	41.0	58.0	58.0	51.0	2400
Zinc	580.0	180.0	380.0	100.0	70.0	5000
Fluoride	136.0	77.0	133.0	190.0	165.0	18000

\* Less than these concentrations.

# APPENDIX F

**TABLE 1 - TRAFFIC CIRCLE SAMPLE AND ANALYSES (continued)**

Date Sampled: 10/08/84

Sample Description

Soil samples found in Fig. F-2

TT6	Fig. F-2
TT7	Fig. F-2
TT8	Fig. F-2
TT9	Fig. F-2
TT10	Fig. F-2

California Assessment Manual (CAM)

Concentration: mg/Kg

CAM METALS	10-83-6	10-83-7	10-83-8	10-83-9	10-83-10	TTLIC
Antimony *	2.0	2.0	2.0	2.0	2.0	500
Arsenic	17.0	16.0	15.0	18.0	17.0	500
Barium	260.0	250.0	250.0	220.0	260.0	10000
Beryllium	0.6	0.5	0.6	1.1	0.6	75
Cadmium	3.5	4.5	3.4	5.2	4.2	100
Chromium, Hexavalent *	0.4	0.4	.4	0.4	0.4	500
Chromium, Trivalent	48.0	50.0	46.0	74.0	52.0	2500
Cobalt	16.0	16.0	15.0	18.0	17.0	8000
Copper	420.0	1400.0	360.0	1000.0	1100.0	2500
Lead	770.0	1200.0	480.0	1000.0	660.0	1000
Mercury	5.7	5.6	3.4	12.0	6.7	20
Molybdenum	4.0	2.0*	4.0	5.0	2.0	3500
Nickel	70.0	86.0	67.0	94.0	87.0	2000
Selenium *	2.0	2.0	2.0	2.0	2.0	100
Silver	2.9	4.7	2.9	18.0	3.6	500
Thallium	4.0	5.0	6.0	5.0	6.0	700
Vanadium	50.0	54.0	44.0	54.0	51.0	2400
Zinc	770.0	900.0	730.0	1000.0	890.0	5000
Fluoride	106.0	147.0	147.0	133.0	155.0	18000

\* Less than these concentrations.

# APPENDIX F

**Table 1 - TRAFFIC CIRCLE SAMPLE AND ANALYSES (continued)**

Date Sampled: 10/09/85

Sample Description

Soil samples found in Figs. F-2 and F-5

TT11	Fig. F-2
TT12	Fig. F-5
TT13	Fig. F-5

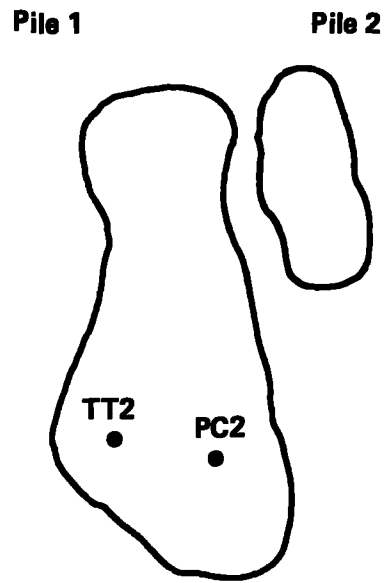
California Assessment Manual (CAM)

Concentration: mg/Kg

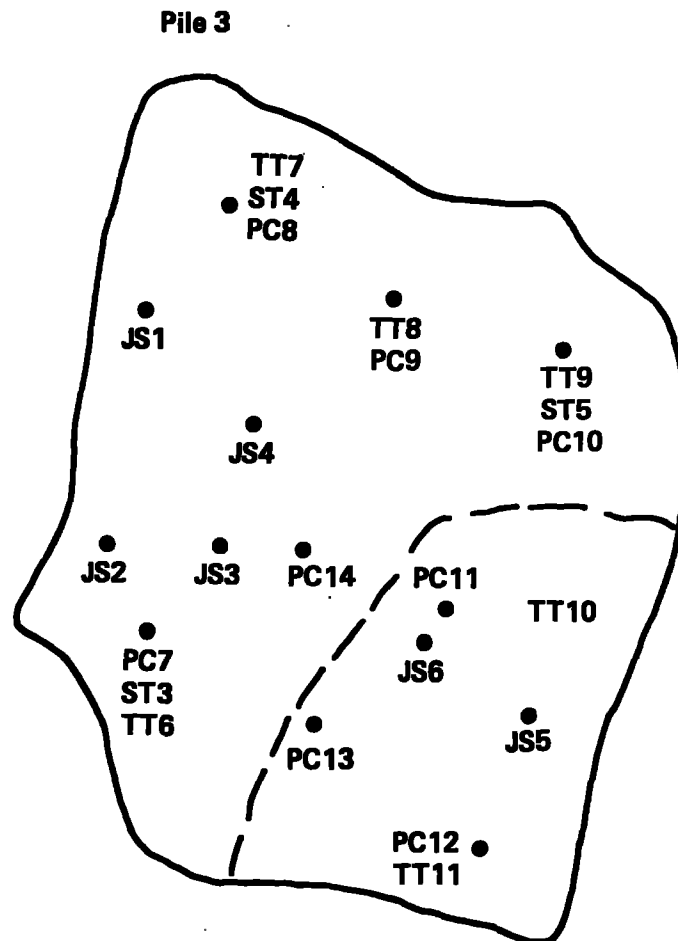
CAM METALS	10-83-11	10-93-1	10-93-2	10-93-3	TTLC	STLC**
Antimony *	2.0	2.0	2.0		500	
Arsenic	18.0	23.0	26.0		500	
Barium	250.0	260.0	230.0		10,000	
Beryllium	0.4	0.8	1.0		75	
Cadmium	2.5	1.1	0.2 *		100	
Chromium, Hexavalent *	0.4	0.4	0.4		500	
Chromium, Trivalent	49.0	31.0	24.0		2500	
Cobalt	14.0	13.0	13.0		8000	
Copper	440.0	220.0	29.0		2500	
Lead	170.0	90.0	27.0		1000	
Mercury	1.7	0.61	0.62		20	
Molybdenum *	2.0	2.0	2.0		3500	
Nickel	72.0	49.0	51.0		2000	
Selenium *	2.0	1.0	1.0		100	
Silver	2.8	1.5	0.6		500	
Thallium	5.0	2.0 *	2.0 *		700	
Vanadium	40.0	35.0	34.0		2400	
Zinc	600.0	280.0	80.0		5000	
Fluoride	140.0	140.0	134.0		1800	

\* Less than these concentrations.

\*\* Soluble Threshold Limit Concentration as specified in the California Assessment Manual (CAM), Criteria for Identification of Hazardous and Extremely Hazardous Wastes. Draft of January 11, 1984.

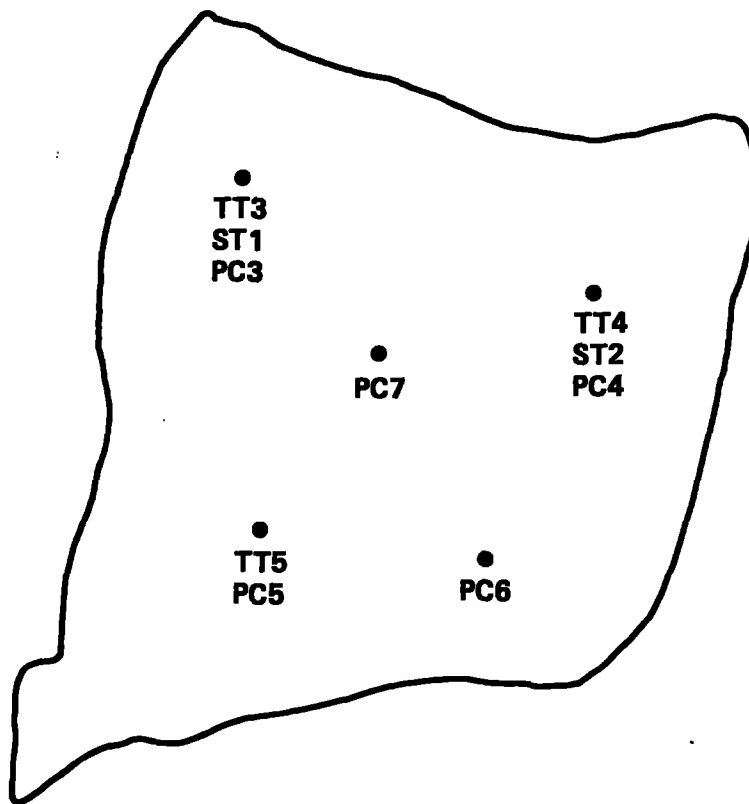


**Figure F-1. Contaminated dirt piles #1 and #2.**



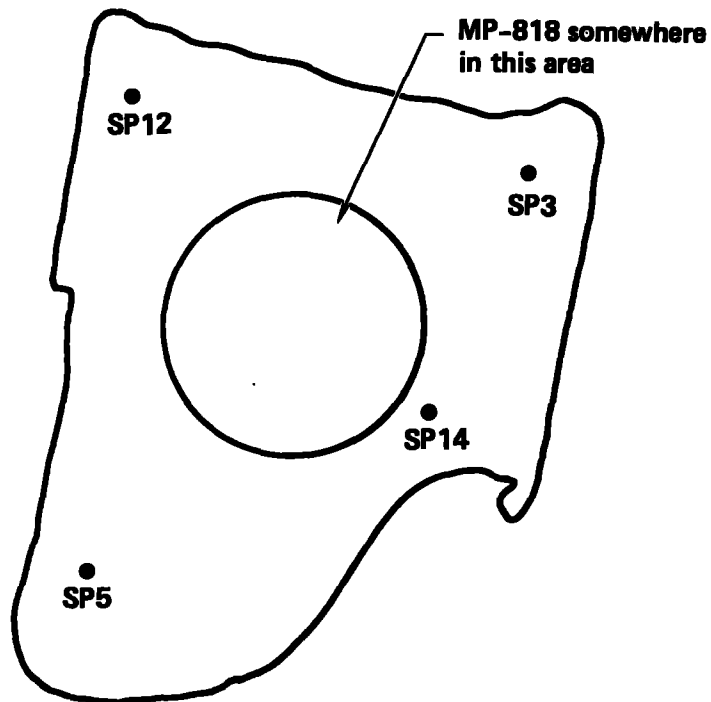
**Figure F-2. Contaminated dirt pile #3.**

**Pile 4**

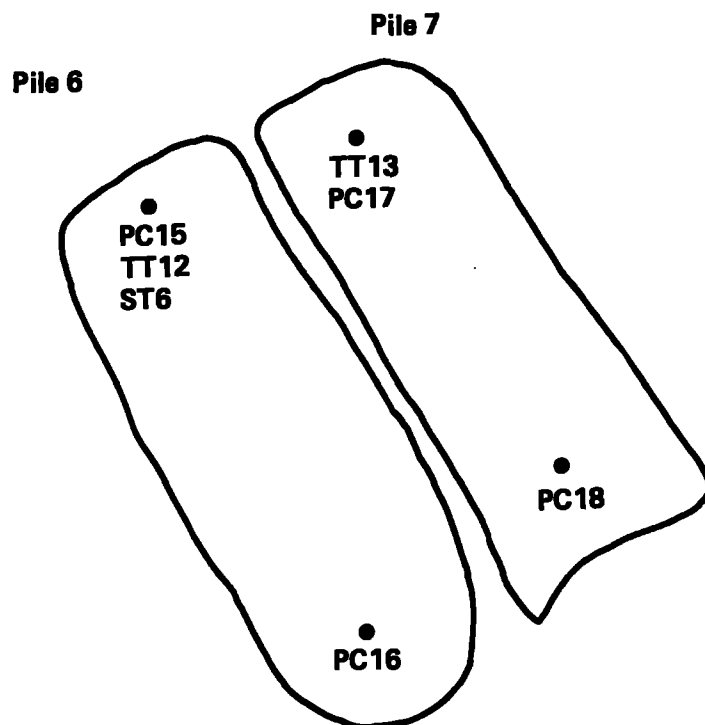


**Figure F-3. Contaminated dirt pile #4.**

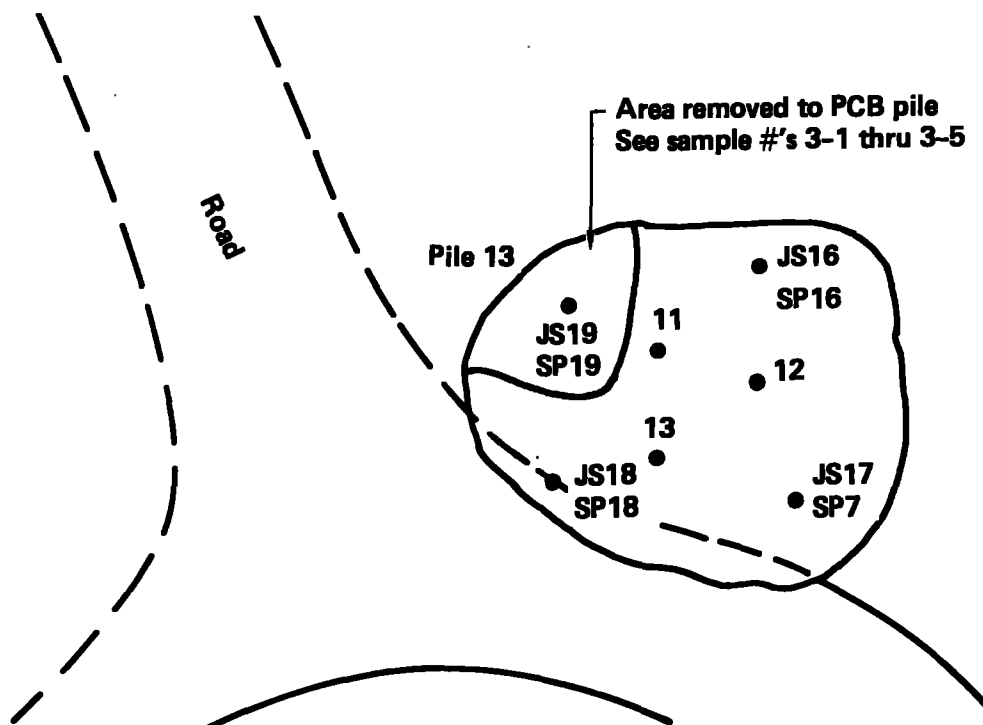
**Pile 5**



**Figure F-4. Contaminated dirt pile #5.**

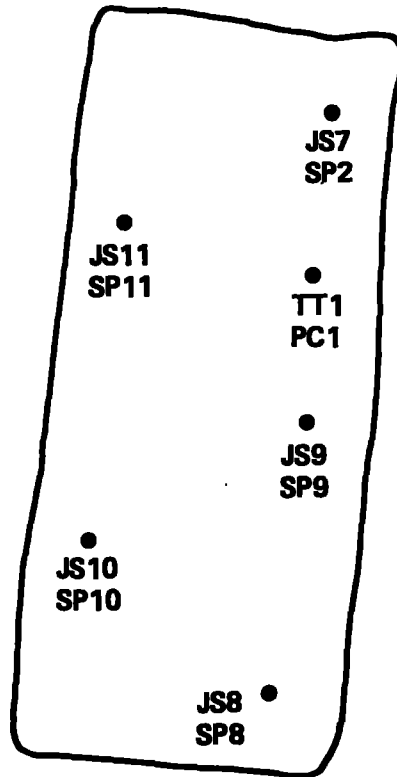


**Figure F-5. Contaminated dirt piles #6 and #7.**



**Figure F-6. Contaminated dirt pile #13.**

**Pile 14**



**Figure F-7. Contaminated dirt pile #14.**

